Appendix A

BIOLOGICAL ASSESSMENT

Environmental Supporting Documentation

C-1	C-2	C-3	C-4	C-5	C-6
Environmental Data Collection and Analyses	**Cost Effectiveness and Incremental Analyses of Mitigation Plans (for Federal Project)**	**Statistical Comparison of Land Loss in the Subbasins: Wetland Loss Analysis for a Deltaic Area in Coastal Louisiana**	**Threatened and Endangered Species Biological Assessment (for Federal and applicant projects)**	**Cultural Resources: State Historic Preservation Officer Correspondence**	**Fish and Wildlife Coordination Act Report (for Federal project)**

This assessment addresses threatened and endangered species that could be affected by the alternatives to provide hurricane protection for Terrebonne and Lafourche Parishes. In response to a Corps' March 19, 1996 request, the National Marine Fisheries Service (NMFS) listed the threatened Gulf sturgeon and five species of endangered or threatened sea turtles [green (threatened), Kemp's ridley (endangered), hawksbill (endangered), leatherback (endangered), and loggerhead (threatened)] that occur in the northern Gulf near the study area. Four species of baleen whales (northern right, sei, finback, and humpback) and one species of toothed whale (sperm whale) are also listed by NMFS as possibly in the Gulf of Mexico near the study area. All are currently listed as endangered. There is no proposed or designated critical habitat for these species in Louisiana. The Fish and Wildlife Service (FWS) noted the bald eagle (threatened), brown pelican (endangered), piping plover (threatened), and Kemp's ridley sea turtle (endangered) as possibly being in or near the study area and under their responsibility. On July 10, 2001, FWS designated critical habitat for the piping plover within the extreme southern portions of the study area. No other critical habitat has been designated in the project area by FWS or NMFS.

The American alligator is listed as threatened due to similarity of appearance. This species is found in waterbodies throughout the fresh to brackish portions of the study area. Louisiana has implemented a commercial harvest season for alligator as its population has risen well above a level of concern. None of the action alternatives would have adverse impacts to the alligator population. Therefore, alligator will not be discussed further in this Biological Assessment.

All the whale species are uncommon to rare in the Gulf of Mexico except for the sperm whale (Burkardt 1996; DOI 1994), which is found in deeper waters and are not likely to be affected, even indirectly, by any of the alternatives studied in detail.

The assessment on sea turtles relies heavily on information from the 1995 Biological Assessment: Impacts of Navigation Channel Hopper Dredging on Threatened and Endangered Species in Louisiana (Baird 1995). Information on sea turtles along coastal Louisiana is generally sparse. Historical and recent occurrences of the Kemp's ridley, loggerhead, green, leatherback, and hawksbill turtles in the vicinity of the three coastal Louisiana channels is summarized, and the potential impacts are discussed.

PROJECT DESCRIPTIONS

The Corps of Engineers, New Orleans District (Corps) and the Terrebonne Levee and Conservation District (formerly South Terrebonne Tidewater Management and Conservation District, STTMCD) have formulated potential plans for the purpose of hurricane protection for areas of Terrebonne and Lafourche Parishes Louisiana. The strategy for an overall hurricane protection system for Terrebonne Parish was to provide flood control and wetlands protection at the same time. The plan envisions as its primary feature, a levee/flood wall, from the western side of Terrebonne Parish, traversing the southern portion of the parish and connecting with the south Lafourche hurricane protection system at Larose. The Feasibility Report/EIS provides details on these plans.

GENERAL BIOLOGY

GULF STURGEON (*Acipenser oxyrinchus desotoi*)

The Gulf sturgeon has been a recognized subspecies of the Atlantic sturgeon since 1985 and inhabits the Atlantic and Pacific oceans and certain freshwaters of the United States. According to Barkuloo (1988) this fish is found in most major river systems from the Mississippi River to the Suwannee River that connect to the Gulf of Mexico and in the central and eastern Gulf of Mexico. They are found mostly in the eastern rivers of the Gulf of Mexico near Florida. Particularly important are the Apalachicola and Suwannee Rivers in Florida.

Gulf sturgeon is an anadramous species, laying eggs in freshwater, moving to the Gulf of Mexico at 3-4 years of age during the fall and winter, and returning to freshwater each spring as river temperatures rise to 16 to 23 C. Wooley and Crateau (1985) found Gulf sturgeon in the Apalachicola River downstream from Jim Woodruff Lock and Dam (river km 171) from May through September. They seemed to concentrate in a large scour hole below the lock, moving very little from the area. The area consisted of sand and gravel substrate, with water depths of 6.0 to 12.0 meters and velocities of 0.6 to 0.9 meters/second. The fish begin to migrate back to estuaries when river temperatures dip below 23 C Wooley and Crateau (1985).

Food of the Gulf sturgeon consists primarily of crab, amphipods, annelids, lancelets, and, brachiopods (Mason and Clugston 1993). However, they do not eat once they enter the rivers in the spring. It remains unclear why most subadult and adult Gulf sturgeon feed in the marine environment for a relatively short time and enter freshwater where they do not feed (USFWS and Gulf States Marine Fisheries Commission 1995).

The Gulf sturgeon can easily attain length over 2 m and live nearly 30 years. Huff (1975) found that mature females ranged in age from 8-17 years and that mature males ranged from 7 to 21 years. Chapman found that mature Gulf sturgeon produce an average of 403,000 eggs. Eggs are demersal and adhesive. Timing, location, and habitat requirements for Gulf sturgeon spawning are not well documented.

The Gulf sturgeon was virtually extirpated throughout its range at the turn of the 20th century. Overexploitation, damming of rivers and other forms of habitat destruction, incidental catch, and water quality deterioration are listed as some of the causes of their decline (Huff 1975; Barkuloo 1988; McDowall 1988; and Birstein 1993).

KEMP'S RIDLEY SEA TURTLE (*Lepidochelys kempi*)
Almost all Kemp's ridley nesting occurs on a single beach at Rancho Nuevo, Mexico, about 30 kilometers south of the Rio Grande. There is some sporadic nesting along the Texas coast. Females arrive in small aggregations known as arribadas from mid-April through August (Rabalais and Rabalais 1980). Based on returns of females tagged on the nesting beach, most adult ridleys move to major foraging grounds to the south in the Campeche-Tabasco region and some move to the northern Gulf of Mexico (Chavez 1969). Members of this genus are usually found in water with low salinity, high turbidity, high organic content, and where shrimp are abundant (Zwinenberg 1977). Such conditions occur where major rivers enter the Gulf.

Stomach analysis of specimens collected in shrimp trawls off Louisiana includes crabs(*Callinectes*), gastropods (*Nassarius*), and clams (*Nuculana*, *Corbula*, and probably *Mulinia*), as well as mud balls, indicating feeding near a mud bottom in an estuarine or bay area (Dobie et al. 1961). Although considered primarily carnivorous benthic feeders (Ernst and Barbour 1972), jellyfish have also been reported as part of their diet (Fritts et al. 1983). Presence of fish such as croaker and spotted seatrout in the gut of stranded individuals in Texas may suggest that turtles feed on the bycatch of shrimp trawlers (Landry 1986).

Precise data regarding the total number of Kemp's ridleys occurring in the Gulf of Mexico are not available. Trends in turtle populations are identified through monitoring of their most accessible life stages on the nesting beaches, where hatchling production and the status of adult females can be directly measured. Population declines of the ridley have been attributed to egg stealing on the localized nesting beach, capture of diurnal nesting females, and fishing and accidental capture in shrimp trawls (Fuller 1978; Pritchard and Marquez 1973).

Film taken in 1947 documented over 40,000 nesting females in a single day during an arribada at Rancho Nuevo (Carr 1963). Bi-national protection and monitoring by Mexico and the United States has occurred on the nesting beach since 1978. Arribadas of up to 200 females have rarely been observed since the beginning of monitoring (U.S. Fish and Wildlife Service [USFWS] and NMFS 1992). Nest production plummeted to only 702 nests in 1985, but has been steadily increasing since that time (Byles, pers. comm.). Over 1,500 nests were observed during the 1994-nesting season, representing the highest nesting year since monitoring was initiated. While these data need to be interpreted cautiously due to expanded monitoring efforts since 1990, an estimated 107,687 hatchlings were released from Rancho Nuevo in 1994, compared to 45,000 to 80,000 from 1987 through 1991 (Byles, pers. comm.). In 1998, there were over 3,700 nests and 183,000 hatchlings; the number of nest declined slightly in 1999 with only 3,600, but hatchlings set a new record with over 225,000 (LSUCES 1999; LSUCES 2000).

Documented evidence and anecdotal accounts suggest a recent upward trend in the Kemp's ridley population. However, the Recovery Plan for the Kemp's ridley sea turtle (*Lepidochelys kempi*) (USFWS and NMFS, 1992) has identified a recovery criteria of 10,000 nesting females in one season as a prerequisite for a determination that Kemp's ridleys can be downlisted to a threatened status. Considering 58 percent of all adult females appear to nest in any one year, and each female lays an estimated 2.7 nests, 1,500 nests documented in 1994 represents less than 1,000 adult female Kemp's ridleys in the entire population. This is less than 2.5 percent of nesting females observed in one day in 1947, and only 5 percent of the downlisting criterion identified in the Recovery Plan.

LOGGERHEAD SEA TURTLE (*Caretta caretta*)
The loggerhead is found in temperate and subtropical waters worldwide. The principal nesting range of the loggerhead is from Cape Lookout, North Carolina, to Mexico. The majority (90 percent) of the reproductive effort in the coastal United States occurs along the south-central east coast of Florida (Hildebrand 1981). Nesting in the northern Gulf outside of Florida occurs primarily on the Chandeleur Islands and to a lesser extent on adjacent Ship, Horn, and Petit Bois Islands in

Mississippi and Alabama (Ogren 1977). Loggerhead eggs were collected from Grand Isle, Louisiana, 50 years ago (Hildebrand 1981). Ogren (1977) reported a historical reproductive assemblage of sea turtles, which nested seasonally on remote barrier beaches of eastern Louisiana, Mississippi, and Alabama. This included Bird, Breton, and Chandeleur Islands in Louisiana.

Loss or degradation of suitable nesting habitat may be the most important factor affecting the nesting population in Louisiana (Ogren 1977). Overall loss of nesting beaches, hatchling disorientation from artificial light, drowning in fishing and shrimping trawls, marine pollution, and plastics and Styrofoam have led to the decline of loggerheads.

Loggerhead turtles are considered turtles of shallow water, less than 50 meters deep (Rabalais and Rabalais 1980). Juvenile loggerheads are thought to utilize bays and estuaries for feeding, while adults prefer waters less than 50 meters deep (Nelson 1986). During aerial surveys of the Gulf of Mexico, the majority (97 percent) of loggerheads were seen off the east and west coasts of Florida (Fritts 1983). Most were observed around mid-day near the surface, possibly related to surface basking behavior (Nelson 1986). Although loggerheads were seen off the coast of Louisiana and Texas, they were 50 times more abundant in Florida than in the western Gulf. The majority of the sightings were in the summer (Fritts et al. 1983). Loggerheads migrate west along with shallow coastal waters, as indicated by telemetry data from an individual tagged in the Mississippi Delta moving to Corpus Christi (Solt 1981).

Loggerheads are frequently observed near offshore oil platforms, natural rock reefs, and rock jetties in Texas. Large numbers of stranded turtles were observed inshore of such areas (Rabalais and Rabalais 1980). Oyster fishermen have reported large turtles near oyster reefs in Louisiana. In a recent tracking study, loggerheads spent more than 90 percent of the time underwater, tended to avoid colder water, and spent much of the time in the vicinity of oil and gas structures (Renaud and Carpenter, in preparation).

Food of loggerheads consists of mollusks, crabs, shrimp, sea urchins, sponges, squid, basket stars, jellyfish, and even mangrove leaves in the shallows (Caldwell et al. 1955; Hendrickson 1980; Nelson 1986). Presence of fish species such as croaker in stomachs of stranded individuals may indicate feeding on the by-catch of shrimp trawling (Landry 1986). They appear to be well adapted for feeding on mollusks with a heavy jaw and head (Hendrickson 1980). Caldwell et al. (1955) suggest that the willingness of the loggerhead to consume any type of invertebrate food permits its range to be limited only by the presence of cold water. In shallow Florida lagoons, loggerheads were found during the morning and evening, leaving the area during mid-day when temperatures reached 31 C. At dusk, turtles moved to a sleeping site and remained there until morning, possibly in response to changes in light or water temperature (Nelson 1986).

GREEN SEA TURTLE (*Chelonia mydas*)

The green turtle has worldwide distribution, concentrated primarily between 35° North and 35° South latitude. Green turtles tend to occur in waters that remain warmer than 20 C; however, there is evidence that they may be buried under mud in a torpid state in waters to 10 C (Ehrhart 1977; Carr et al. 1979). This species migrates between feeding and nesting areas, often over long distances (Carr and Hirth 1962). It is a large sea turtle with carapace length in adults commonly reaching one meter (NMFS and USFWS 1991).

In the United States' Atlantic waters, green turtles nest in small numbers in the U.S. Virgin Islands and Puerto Rico, and in larger numbers along the east coast of Florida. Estimates of age at sexual maturity range from 20 to 50 years (Balazs 1982; Frazer and Ehrhart 1985) and they may live over 100 years Zug et al. (1986).

During their first year of life, green sea turtles are thought to feed mainly on invertebrates, with adults preferring an herbivorous diet and frequenting shallow water flats for feeding (Fritts et al. 1983). The adult turtle feeds primarily on seagrasses (i.e., *Thalassia testudinum* and turtle grass), which have a high fiber content and low forage quality (Bjorndal 1981a) and algae (Bjorndal 1985). The Caribbean green turtle is considered by Bjorndal (l981b) to be nutrient-limited, resulting in low growth rate, delayed sexual maturity, and low annual reproductive effort. This low reproductive effort makes recovery of the species slow once the adult population numbers have been severely reduced (Bjorndal 1981). In the Gulf of Mexico, principal "feeding pastures" are located in the upper west coast of Florida (Hirth 1971). Nocturnal resting sites may be a considerable distance from feeding areas, and distribution of the species is generally correlated with grassbed distribution, location of resting beaches, and possibly ocean currents (Hirth 1971).

Immediately after hatching, green turtles swim past the surf and other shoreline obstructions, primarily at depths of 20 centimeters or less below the water surface, and are dispersed both by vigorous swimming and surface currents (Frick 1976; Balzas 1980). The whereabouts of hatchlings to juvenile size (35 centimeters) is uncertain. In the Hawaiian Archipelago, juveniles greater than 35 centimeters in length, as well as subadults, feed and rest in shallower coastal areas than adults. Hawaiian adult and immature turtles come inshore at certain undisturbed sites to bask or rest (Balzas 1980). Green turtles tracked in Texas waters spent more time on the surface, with fewer submergences at night than during the day, and a very small percentage of the time was spent in the Federally maintained navigation channels. The tracked turtles tended to utilize jetties, particularly outside of them, for foraging habitat (Renaud et. al. 1993).

Most green turtle populations have been depleted or endangered because of direct exploitation or incidental drowning in trawl nets (King 1981). Defunct green turtle fisheries in Louisiana and Texas indicate it was more common in areas where it is now rare (Rebel 1974, in Fritts et al. 1983). In Texas in the 1800's, the green turtle fishery was the first to appear and disappear. Animals were captured from April to November, primarily when they were returning to diurnal feeding areas from nocturnal resting places in deeper waters of bays (Hildebrand 1981). Green turtles in Texas still inhabit the same seagrass meadows as at the turn of the century, although in reduced numbers (Hildebrand 1981). In Florida, the nesting population was nearly extirpated within 100 years of the initiation of commercial exploitation (King 1981).

LEATHERBACK SEA TURTLE (*Dermochelys coriacea*)

The leatherback is the largest sea turtle and is highly migratory, is the most pelagic of all sea turtles (NMFS and USFWS 1992), and is commonly occurring in continental shelf waters (Pritchard 1971; Hirth 1980; Fritts et al. 1983). It is a temperate zone form with a tropical nesting range (Ross 1981). Distribution of this species has been linked to thermal preference and seasonal fluctuations in the Gulf Stream and other warm water features (Fritts et al. 1983). General decline of this species is attributed to exploitation of eggs (Ross 1981).

Nesting of leatherback turtles is nocturnal with nesting in the United States in the Gulf of Mexico (Florida) from April to late July (Pritchard 1971; Fuller 1978; Fritts et al. 1983). The Pacific coast of Mexico supports the worlds largest known concentration of nesting leatherbacks. There is very little nesting in the United States and no nesting has been reported from Louisiana (Gunter 1981). A small number nest on the west coast of Florida from April to late July (Pritchard 1971; Fulller 1978; Fritts 1983).

Leatherback turtles feed primarily on jellyfish and other coelenterates. They will also ingest plastic bags and other plastic debris, which is commonly generated by oil drilling rigs and production platforms in coastal Louisiana (Fritts et al. 1983).

HAWKSBILL SEA TURTLE (*Eretmochelys imbricata*)

The hawksbill turtle is the second smallest sea turtle being somewhat larger than the Kemp's ridley. Nesting females average about 87 cm in curved carapace length (Eckert 1992). The adults are easily recognized by their thick carapace scutes, usually with radiating brown and black streaks on an amber background, and a jagged posterior margin on the carapace. The name of the turtle is derived from the tapered beak and narrow head.

These turtles generally live most of their life in tropical waters such as the warmer parts of the Atlantic Ocean, Gulf of Mexico and the Caribbean Sea (Carr 1952 and Witzell 1983). Florida and Texas are the only states where hawksbills are sighted with any regularity (NMFS and USFWS 1993). They are extremely rare in Louisiana waters.

Hawksbills nest throughout their range, but most of the nesting occurs on restricted beaches, to which they return each time they nest. The hawksbill breeds and nests in a diffuse rather than colonial nesting pattern in warm waters between 25^{o} North and 25^{o} South latitude (Rebel 1974). These turtles are some of the most solitary nesters of all the sea turtles. Depending on location, nesting may occur from April through November (Fuller et al. 1987). These turtles prefer to nest on clean beaches with greater oceanic exposure than those preferred by green sea turtles, although they are often found together on the same beach. The nesting sites are usually on beaches with a fine gravel texture. Hawksbills have been found in a variety of beach habitats ranging from pocket beaches only several yards wide formed between rock crevices to a low-energy sand beach with woody vegetation near the waterline. These turtles tend to use nesting sites where vegetation is close to the waters edge. They do not nest in Louisiana.

Mating takes place offshore near the nesting sites. Males rarely come ashore. Mature females come to shore at night to prepare nests at the upper part of the beach. Females nest several times a season and have up to 200 eggs per clutch (NMFS and USFWS 1993). Each female may not reproduce every year. Young turtles dig out of nests and go to sea in search of food. Large numbers of young are normally lost to predation. Since the juvenile mortality rate is high, rapid growth and adult longevity tend to make most turtle populations consist of mainly larger turtles.

Juvenile hawksbills are normally found in waters less than 15 meters in depth. Areas around coral reefs, shoals, lagoons, lagoon channels and bays with marine vegetation that provides both protection and plant and animal food. The hawksbill can tolerate muddy bottoms with sparse vegetation unlike the green turtles.

The hawksbill was once thought to be a generalist or opportunistic feeder but studies now indicate that the primary food source is comprised of sponges and other encrusting organisms. Other organisms found in the diet are now believed to be incidental organisms living in association with the sponges which are being used for food (Meylan 1988). Adults forage around reefs up to 100 meters in depth and are not usually in shallow waters less than 20 meters in depth. Juveniles forage in shallow waters near the shallowest coral reefs. Offshore behavior of the turtles is not well understood. Both single and mated pairs of adult turtles and juveniles as well have been observed in all seasons in the Caribbean. It is thought they are foraging on the live bottom sponges in the area.

The hawksbill is probably a diurnal species and only feeds in daylight in captivity. These turtles go through a pelagic feeding phase as hatchlings and are normally associated with seaweed mats. During this phase the juveniles feed on the shallow reefs until they reach a length of 15-25 centimeters. As the turtles mature, they move from pelagic feeders to benthic feeders. With this change in feeding habits the foraging territory is moved further and further from shore to the deeper waters as the turtle improves its capability for deep dives.

SEA TURTLES IN THE GULF OF MEXICO

Inshore areas of the Gulf of Mexico appear to be important habitats for the Kemp's ridley. Members of this genus are characteristically found in waters of low salinity, high turbidity, high organic content, and where shrimp are abundant (Zwinenberg 1977, Hughes 1972). Adults tagged at Rancho Nuevo were recaptured off coastal Louisiana and in Vermilion Bay, and animals have been reported from Vermilion Parish to Terrebonne Parish (Pritchard and Marquez 1973; Chavez 1969; Keiser 1976; Zwinenberg 1977; Dobie et al. 1961). Ridleys are commonly captured by shrimpers off the Texas coast and in heavily trawled areas of the Louisiana and Alabama coast (Pritchard and Marquez 1973; Carr 1980).

Kemp's ridley has been labeled the "Louisiana turtle" by Hildebrand (1981) and is thought to be the most abundant turtle off the Louisiana coast (Viosca 1961; Gunter 1981). The highly productive white shrimp-portunid crab beds of Louisiana from Marsh Island to the Mississippi Delta, south of the study area are thought to be the major feeding grounds for subadult and adult ridley (Hildebrand 1981). The current patterns in the Gulf of Mexico could aid in transport of individuals, where small turtles would enter the major clockwise loop current of the western Gulf of Mexico, carrying individuals north and east along Texas, Louisiana, and other northern Gulf areas (Pritchard and Marquez 1973; Hildebrand 1981).

Beginning in April 1994, unprecedented numbers of dead sea turtles beached along the coasts of Louisiana and Texas. During 1994, a total of 174 turtles, including 134 Kemp's ridleys, stranded in Louisiana. An additional 488 turtles stranded on offshore Texas beaches during 1994, including almost 243 Kemp's ridley turtles and 190 loggerheads. The apparent cause of most of the strandings was the simultaneous occurrence of an intensive pulse of shrimping in an area of high Kemp's ridley abundance during 1994. Information regarding whether the abundance of sea turtles in the northern Gulf was a seasonal anomaly, or represents the current status of sea turtles in nearshore waters, is not available. The Louisiana Sea Turtle Stranding and Salvage Network (LA-STSSN) registered 373 sea turtles stranded on Louisiana beaches from 1990 through 1994. Of these, 268 were Kemp's ridleys, and 41 were unidentified (Koike 1995).

Stomach content analyses on sea turtles stranded in Texas suggest that, in all years, most mortalities occur in nearshore waters. Stomach contents of Kemp's ridleys along the lower Texas coast also showed a predominance of nearshore crabs and mollusks, as well as fish, shrimp and other foods considered to be shrimp fishery discards (Shaver 1991). Over 150 Kemp's ridleys have been intentionally live-captured by research gillnets in 1993 and 1994 at Sabine Pass by Texas A&M University scientists conducting research for the Corps of Engineers. This illustrates the availability of ridleys to human interactions in north Texas waters.

Findings of ongoing research conducted by NMFS scientists support the likelihood that the nearshore waters of Texas and Louisiana provide important developmental habitat for young loggerheads and Kemp's ridley sea turtles. Ogren (1988) suggests that the Gulf Coast from Port Aransas, Texas, through Cedar Key, Florida, represents the primary habitat for subadult ridleys in the northern Gulf of Mexico. One hundred and thirty turtles have been tracked by NMFS Galveston Lab staff since 1980, including 91 ridleys tracked since September 1988 with Corps support. Preliminary analysis of data collected suggests that subadult Kemp's ridleys occupy shallow, warm, nearshore waters in the northern Gulf of Mexico until cooling waters force them offshore or south along the Florida Coast (Renaud, pers. comm.) Juvenile ridleys are usually found in waters of 9 meters or less, and all ridleys are generally found in water depths less than 18 meters (Renaud, draft in-house report transmitted December 8, 1994).

In addition to the NMFS studies, satellite transmitters have been applied to approximately 50 adult female Kemp's ridleys over the last decade to identify the movements of the females after leaving the nesting beach in Rancho Nuevo, Mexico (Byles, unpublished data). While most female ridleys head south towards the Bay of Campeche after leaving the beach, two out of eight turtles headed into nearshore Texas waters during one year's study. In 1994, of four turtles that were tagged, three went south and one went as far north as the vicinity of the mouth of the Mississippi River (Byles, pers. comm.) Clearly, reproductively active Kemp's ridleys, which are directly required for the recovery of the population, are found within the U.S. Gulf of Mexico, and are as vulnerable to human impacts as sub-adults.

Loggerhead turtle strandings have been reported in Louisiana from Cameron (Fuller 1986) as well as Holly Beach in August, and Isles Dernieres in July (SEAN 1980). A tagged loggerhead was recaptured near Grand Isle at Belle Pass (Lund 1974). More recently, LA-STSSN registered 45 loggerheads stranded on Louisiana beaches from 1990 through 1994. This represented 12 percent of the sea turtles stranded, second only to the Kemp's ridley.

Studies conducted on loggerheads stranded on the lower Texas coast (south of Matagorda Island) have indicated that stranded individuals were feeding in nearshore waters shortly before their death (Plotkin et al. 1993). Recent capture and telemetry studies of sea turtle movements along the northern Gulf of Mexico showed usage of the nearshore areas near jetties and channels. Kemp's ridleys were captured most frequently, and loggerheads were the second most frequently captured in Texas and Louisiana waters.

Historical sightings of green turtles by fishermen in Louisiana occurred gulfward of Isles Dernieres and Timbalier Islands in spring, summer, and fall. Recent sightings have been reported from the northwest areas of Terrebonne Bay in summer and off Belle Pass in fall (Fuller 1986). A green turtle also has been reported from the Chandeleur Islands (Viosca 1961). A green turtle was found in June on Grand Terre near Fort Livingston (SEAN 1980). No green turtles were observed during an aerial survey in Louisiana or Texas in 1979, possibly due to low abundance as well as identification problems. Green turtle stranding records, and turtle fishing records from Louisiana and Texas combined, are one-third that reported from Florida (Fritts et al. 1983). LA-STSSN registered 10 green turtles stranded on Louisiana beaches from 1990 through 1994. This represented 2.7 percent of the sea turtles stranded.

Historical sightings of leatherback turtles have been reported in Louisiana from Terrebonne Bay and Timbalier Bay. Sightings were noted by helicopter pilots in National Marine Fisheries Service statistical zones 12, 14 and 17 in January, March, and April (Fuller 1986). These zones include the area off Isles Dernieres and Timbalier Islands (Area 14) and off Cameron (Area 17). Leatherback turtles have been reported in aerial surveys off Marsh Island in April. They were observed in waters of a depth of 20 meters and 330 meters, approximately 55 and 190 kilometers from shore, respectively (Fritts et al. 1983). Low numbers of leatherback turtles reported by fishermen in coastal Louisiana may reflect low numbers in the area, or lack of fishing in areas where the species would occur (Fuller 1986). Only eight leatherbacks were stranded on Louisiana beaches from 1990 through 1994.

While there have been no sightings of hawksbill turtles in the proposed area of work, one was reported from a gillnet catch in Cameron Parish, Louisiana, in the 1986 survey of Louisiana coastal waters by the National Marine Fisheries Survey (Fuller et al. 1987). This supports the general belief that hawksbills are scarce in Louisiana waters. The stranding network data from 1990 through 1994 reported only one hawksbill stranding in Louisiana.

The LA-STSSN data (1990-1994) shows that of the reported 373 turtles stranded in Louisiana, approximately 60 percent were in Cameron Parish and 26 percent were in Jefferson Parish. Strandings in Lafourche Parish were somewhat frequent (eight percent), but the number of strandings in Terrebonne Parish was low (one percent). It should be noted that because of differences in beach access and coastline irregularities, reports are likely to reflect these influences.

PIPING PLOVER (*Charadrius melodus*)
Piping plovers breed in northern latitudes in three geographic regions and winter along the south Atlantic and Gulf coasts, including coastal Louisiana. Overwintering populations in Louisiana occur on beaches, sandflats, and dunes in Cameron Parish in the west and Jefferson Parish (Grand Terre Island and Grand Isle) in the east in 1987 (USFWS 1988). Numbers are highly variable, based on recent census data provided by Steve Shively of the Louisiana Department of Wildlife and Fisheries. They do occur on the Isle Dernieres barrier island chain in Terrebonne Parish. Historically, piping plovers also have been reported from Calcasieu, Vermilion, East Baton Rouge, and Orleans parishes. Not much is known about their nonbreeding habitat.

Piping plovers begin arriving at the northern United States and southern Canada breeding grounds in mid-April (Prindiville 1986). They are known to nest with least tern, arctic terns, and common terns (USFWS 1985; Cairns 1977). They breed in open, sparsely vegetated habitats that are slightly raised in elevation. Egg laying occurs in May with clutch size equaling four and 1-2 chicks fledging at about four weeks old (Haig and Oring 1985). The adults leave nesting grounds in late July-early August, with the uveniles following a few weeks later (Wiens 1986). Birds normally return to the same breeding area (Haig 1987), but occasionally they go to other areas (Haig and Oring 1988).

Primary prey for wintering plover includes polychaete marine worm, various crustaceans, insects, and occasionally bivalve mollusks. Chicks feed on smaller sizes of these same foods shortly after they hatch.

There were just over 2,000 breeding pairs in 1986-1987. This number is not comparable to historical numbers because data is lacking. Piping plovers can apparently live five years or somewhat longer (Wilcox 1957). In 1990 there were an estimated 1,840 breeding pairs (FWS 1991).

Critical habitat has been designated for piping plovers in both their breeding and wintering grounds. Their designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering, and the physical features necessary for maintaining the natural processes that support these habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide) and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent un-vegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers.

BROWN PELICAN (*Pelecanus occidentalis carolinensis*)
The eastern brown pelican is found along the Atlantic coast from North Carolina to Florida and along the Gulf coast to northern South America; it also ranges along the Pacific coast from southern Mexico to Columbia. It was extirpated from Louisiana in the late 1950's and early 1960's (McNease et al. 1984) primarily because of organochlorine pesticides in the

food chain. They were reintroduced into Louisiana from Florida from 1968 to 1980 and nesting populations were established on North Island in the Chandeleur Islands and Queen Bess Island in Barataria Bay, southeast of the study area (Hingtgen et al. 1985). Additional nesting colonies were later established on Isles Dernieres, south of the study area and natural expansion has established colonies on Mississippi River mud lumps, on Grand Gosier Island in the Chandeleur Islands (McNease et al. 1992), and Baptiste Collette. In 1993-1994, about 20,000 fledglings were produced in Louisiana and in 1995 the number rose to 16,000 (LDWF data).

Eastern brown pelicans begin to breed when they are 3 to 5 years old (Blus and Keahey 1978). They live to be about 20 years old (Clapp et al. 1982). They begin nesting in Louisiana during February with eggs normally laid for three months and up to six months. Clutch size is usually three eggs. In Louisiana, about 1.6 young are fledged from each nest (LDWF data). Production of young fledgings requires about 18 weeks (Schreiber 1979). The principal source of eastern brown pelican nesting failure is direct and indirect human interference with nesting colonies (Clapp et al. 1982). Pelicans disperse southward and probably winter south of the United States (Schreiber and Schreiber 1983).

The pelicans forage primarily in shallow estuarine waters (Schreiber 1978) and in ocean waters within 32 km of shore. Food consists mainly of gulf menhaden, mullet, and other species of forage fish (Krantz 1968) normally less than 25 cm. They plunge-dive from heights of up to 20 m to capture prey with their bill and pouch (Schreiber et al. 1975) in the top 1 m of water (Schnell et al. 1983).

BALD EAGLE (*Haliaeetus leucocephalus*)
The bald eagle (*Haliaeetus leucocephalus*) is a raptor that is found in various areas throughout the United States and Canada. Populations experienced drastic declines from the 1940's to the 1970's (Grier 1982), but populations are on the rebound. The ban on the use of DDT in the United States in 1972 resulted in higher productivity nationwide (Peterson 1986). In 1995, the bald eagle was downlisted from an endangered status to a threatened status in most of the lower 48 states, including Louisiana. This species prefers habitat near large rivers, lakes, and estuaries and occurs throughout Louisiana. From 1989 to 1995 the number of nests and number of young produced has been steadily increasing (LDWF data) such that 157 eagles were produced in 1995. There are at least 30 documented (i.e., present and historical) bald eagle nest locations within the study area, all are in the northern portion (where larger trees are found) as would be expected and most are in subbasin A, west of Bayou du Large.

Bald eagles begin nesting in September with the peak egg laying in December. Clutch size ranges from 1-3 eggs and fledging takes 10-12 weeks (Murphy et al. 1989). The birds then tend to move north up to 1,000 miles. The main basis of the bald eagle diet is fish (DeGraff et al. 1980), but they will feed on other items such as birds and carrion depending upon availability of the various foods. Eagles require roosting and nesting habitat, which in Louisiana consists of large trees in fairly open stands (Anthony et al. 1982).

Bald eagles can be disturbed by human activity, including recreation (Boyle and Samson 1985; Stalmaster and Kaiser 1998). McGarigal et al. (1991) found that eagles generally avoid foraging within a 400-meter radius around areas with human boating activities (McGarigal et al. 1991).

FINBACK WHALE (*Balaenoptera physalus*)
The finback whale is the second largest baleen whale. It feeds primarily on krill and small schooling fish. In the western north Atlantic they occur from Greenland south to the Gulf of Mexico and the Caribbean Sea (Leatherwood et al. 1976). They may occur year-round in the Gulf of Mexico; however, no finbacks were sighted during aerial surveys conducted in 1980-1981 (Fritts et al. 1983a).

Finbacks have stranded in the Gulf of Mexico along the coasts of Florida, Louisiana, and Texas. Standing records for Louisiana include Isles Dernieres off Terrebonne Parish in 1915, Pelican Island on the western edge of Breton Sound in 1917, near Sabine Pass in 1924, the Chandeleur Islands in 1928, and in the marsh west of Venice in 1968 (Lowery 1974). A whale that stranded in Mississippi Sound in 1967 was originally reported as a finback but was later determined to be a sei whale.

HUMPBACK WHALE (*Megaptera novaeangliae*)
Humpback whales occur in all oceans. They are a coastal species and feed primarily on krill and fish. The western north Atlantic stock is migratory. Their summer range is from Cape Cod to Iceland, and their winter calving grounds are in the Caribbean Sea (Schmidldy 1981).

The only recent record for the Gulf of Mexico is of an individual sighted in 1962 at the mouth of Tampa Bay (Layne 1965).

RIGHT WHALE (*Eubaleana glacialis*)
Right whales occur in the temperate waters of the north Atlantic, the north Pacific, and the southern hemisphere. In the western north Atlantic, right whales are distributed from Iceland to Florida and the Gulf of Mexico (Leatherwood 1976).

They have been recorded only twice from the Gulf of Mexico and their status is questionable. Two right whales were reported off New Pass, Florida in 1963, and in 1972 one washed ashore near Freeport, Texas (Schmidly 1981).

SEI WHALE (*Balaenoptera borealis*)
Sei whales occur in all oceans, but are rare in tropical and polar seas. They are widely distributed in nearshore and offshore waters of the western north Atlantic from the Gulf of Mexico and the Caribbean Sea to Nova Scotia and Newfoundland (Leatherwood et al. 1976).

Records from the Gulf of Mexico are limited to strandings near Campeched, Mexico and the coasts of Louisiana and Mississippi. The record from Louisiana is of an individual that stranded near Fort Bayou on the western edge of Breton Sound in 1956. The record from Mississippi is of the specimen originally reported as a finback whale. This whale entered Mississippi Sound in 1967 and subsequently died near the entrance to the harbor at Gulfport, Mississippi (Gunter and Christmas 1973). The authors believed this occurrence would not have been possible except for the deep navigation channel leading into Gulfport.

SPERM WHALE (*Physeter catodon*)
Sperm whales were once quite numerous in the Gulf of Mexico, enough so to justify full-scale commercial whaling operations (Lowery 1974). Although no longer common in the Gulf of Mexico, the species has been observed on several occasions in recent years off the mouth of the Mississippi River by fishermen and personnel on exploratory research vessels of the NMFS (Lowerey 1974). Sperm whales were observed 229 miles off the coast of Louisiana in 1980 by Fritts et al. 1983a.

Three strandings along the coast of Louisiana have been reported. An individual stranded near Sabine Pass in 1910, another stranded in 1960 at the mouth of the Mississippi River near Pass a Loutre, and a third stranded on the central coast of Louisiana in Terrebonne Parish in 1977 (Schmidly 1981).

IMPACTS ON THREATENED AND ENDANDERED SPECIES
Recent research has shown that sea turtles are virtually absent from the nearshore waters of the northern Gulf from December through March (Renaud et al. 1995) and would not ever be present far enough inland to be directly impacted by any of the alternatives. This leaves only the possibility of indirect and/or cumulative impacts to sea turtles. Hawksbill and leatherback sea turtles are very unlikely to occur near the study area. Green and loggerhead sea turtles are unlikely to occur, but Kemp's ridley sea turtles may be found in coastal waters near the study area during the summer. Sea turtles (Kemp's ridley) are known to occur in the nearshore environment of the Gulf of Mexico some 15 km (9 miles) south of the closest possible work areas along Highway 57. Therefore, dredging and other construction activities would not be expected to impact areas occupied by Kemp's ridley sea turtle.

Whales are extremely unlikely to be found anywhere near the study area. No adverse impacts would be expected to whales with any of the alternatives.

Piping plover do overwinter in southern most portion of the study area but not within the actual impact area of the recommended plan so they would not be adversely impacted.

Eastern brown pelicans occur in the study area, particularly immature pelicans. Nesting does occur on Racoon Island, which is within the study area. The species also feeds and roosts in the study area. At this time, no adverse impacts are anticipated. As each segment of the levee alignment undergoes detail design, a supplemental NEPA document will revisit this determination.

Bald eagles nest in northern Terrebonne and Lafourche Parishes, primarily west of Bayou du Large. Construction activities within 3,000 feet of bald eagles could be disruptive to feeding and nesting and should be avoided from October through mid-May. Cutting of bald eagle nest trees, or damaging its root system, is strictly prohibited at any time. As each segment of the levee alignment undergoes detail design, a supplemental NEPA document will revisit this determination. As part of this, an aerial survey may be conducted to determine the presence of undocumented eagle nests.

CONCLUSIONS
Neither of the two action alternatives would have adverse impacts upon threatened and endangered species, provided that work areas do not expand to the south of the study area and that the precautions noted above for bald eagle are followed.

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C-1 C-2 C-3 C-4 C-5 C-6

Appendix B

FISH AND WILDLIFE COORDINATION ACT REPORT

MISSISSIPPI RIVER AND TRIBUTARIES
MORGANZA TO THE GULF OF MEXICO
LOUISIANA
POST AUTHORIZATION CHANGE REPORT

DRAFT
FISH AND WILDLIFE COORDINATION ACT REPORT

U.S. FISH AND WILDLIFE SERVICE

ECOLOGICAL SERVICES

LAFAYETTE, LOUISIANA

May 2012

MISSISSIPPI RIVER AND TRIBUTARIES
MORGANZA TO THE GULF OF MEXICO
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POST AUTHORIZATION CHANGE REPORT

DRAFT
FISH AND WILDLIFE COORDINATION ACT REPORT

SUBMITTED TO

NEW ORLEANS DISTRICT

U.S. ARMY CORPS OF ENGINEERS

NEW ORLEANS, LOUISIANA

PREPARED BY

RONNY PAILLE
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U.S. FISH AND WILDLIFE SERVICE

ECOLOGICAL SERVICES

LAFAYETTE, LOUISIANA

MAY 2012

Executive Summary

The U.S. Fish and Wildlife Service has prepared a draft Fish and Wildlife Coordination Act Report on the U.S. Army Corps of Engineers' (Corps) Mississippi River and Tributaries – Morganza to the Gulf of Mexico, Louisiana, Post Authorization Change Report. The objectives of that study are to reduce hurricane-related damages up to the 100-year recurrent frequency storm event, and to reduce coastal wetland loss due to storm surges and associated saltwater intrusion and wave-erosion.

The study area comprises much of the coastal wetlands of the central and eastern Terrebonne Basin. Those wetlands support nationally important fish and wildlife resources, but are experiencing rapid deterioration and loss. Through the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), the Corps, the Service, and other Federal and State agencies have jointly developed strategies to protect and restore Louisiana's coastal wetlands, including those in the Terrebonne Basin. The two strategies that may be affected by the proposed project include the enhancement of Atchafalaya River freshwater inflows and the elimination of saltwater intrusion from the Houma Navigation Canal (HNC).

Because the study authorization includes wetland restoration, project features should at a minimum avoid conflicts with existing restoration strategies and projects. Ideally, Morganza features such as the HNC Lock and others, should achieve both restoration and protection benefits.

The Corps has developed a system-wide hydrologic model to assess hydrology impacts of the Tentatively Selected Plan (TSP). Model results suggest that the TSP will have minimal adverse impact on existing area hydrology and may have some beneficial salinity reduction effects. However, the study schedule has precluded a thorough assessment of project indirect effects. Based on available information, and given the uncertainties associated with that information, the Habitat Evaluation Team (HET) has determined that indirect impacts and benefits cannot be adequately determined and that those net indirect impacts and benefits would likely be minimal. Quantified impacts therefore consist solely of direct construction impacts.

Of the two alternative plans evaluated under this Feasibility Study, the Corps has selected the 100-yr frequency storm protection alternative. Based on the provided construction schedule, and using the medium sea level rise (SLR) impact assessment, construction of the TSP would result in a loss of 235 acres of bottomland hardwood forest, 526 acres of cypress swamp, and 2,117 acres of marsh. Because detailed engineering and design is not available for most levee reaches and structures, only levee reaches F1, F2, G1, the HNC Lock and the Bayou Grand Caillou Floodgate will be proposed for construction authorization. Construction of those levee reaches and structures would result in the direct loss of 670 acres of marsh and 390.5 AAHUs over the project life. Those impacts would be mitigated by creating 137 acres of intermediate marsh and 776 acres of brackish marsh.

Because of the complexity and scope of this study, many details regarding the design and operation of project features must be addressed during the post-authorization phase; hence, precise estimates of project-related impacts/benefits associated with all project features cannot be provided until the designs of all project features are finalized. Because designs for several critical floodgates have not yet been completed, the assessment of local and system-wide hydrology

effects cannot yet be concluded and additional hydrologic impact assessments will be needed.

Extensive coordination between the Corps and the Service will be required throughout the post-authorization phase to ensure that impacts to coastal wetlands and associated fish and wildlife resources are avoided and minimized to the greatest degree possible and that adequate and effective mitigation measures are implemented to compensate for unavoidable impacts.

Substantial direct wetland losses will result from construction of project features. Consequently, avoidance and minimization of direct wetland impacts should be pursued to the greatest extent practicable. The Service does not oppose the implementation of the constructable features and provides the following recommendations to avoid and/or minimize project impacts on fish and wildlife resources, and for mitigating unavoidable impacts to those resources.

1. The Post Authorization Report, in keeping with the project's Congressional Authorization, should clearly reiterate that features of the Tentatively Selected Plan will be designed to maintain existing freshwater inflows from the Atchafalaya River via the Gulf Intracoastal Waterway. Those designs shall accommodate newly identified restoration needs determined via future restoration planning, to the extent possible. The Service also recommends that the Corps provide the Service with the opportunity to review and comment on model assumptions and input data prior to initiating the modeling analyses necessary to complete those tasks. Tasks should include the following:

    a. Future design of the Grand Bayou Canal Floodgate should accommodate southward freshwater flows determined via the LCA Convey Atchafalaya River Water to Northern Terrebonne Project's ongoing assessment of Grand Bayou restoration alternatives.
    b. Construction of Reach L and K levees should avoid use of material dredged from Grand Bayou Canal and from the Cutoff Canal so that saltwater intrusion via those channels is not increased.
    c. The east GIWW floodgate should have the smallest possible cross-section to reduce the loss of Atchafalaya River freshwater to the Barataria Basin and to retain that freshwater within the Terrebonne Basin.
    d. The design of the west GIWW floodgate should avoid stage increases west of that structure and should be capable of passing Atchafalaya River freshwater flows, especially during periods of high Atchafalaya River stages, without any loss of flow .
    e. The two environmental water control structures at Falgout Canal should be designed and operated to only discharge freshwater southward and not to allow northward flow of saltwater into Falgout Canal.

2. The Corps should coordinate closely with the Service and other fish and wildlife conservation agencies throughout the engineering and design of project features including levees, floodgates, and environmental water control structures to ensure that those features are designed, constructed and operated consistent with wetland restoration and associated fish and wildlife resource needs.

3. Operational plans for floodgates and water control structures, excluding the Falgout Canal structure, should be developed to maximize the cross-sectional area open for as long as possible. Operations to maximize freshwater retention or redirect freshwater flows could be considered if hydraulic modeling demonstrates that is possible and such actions are recommended by the natural resource agencies. Development of water control manuals or plans should be done in coordination with the Service and other natural resource agencies.

4. The location of the Barrier Reach and Reach A levees should be modified to reduce direct wetland impacts and enclosure of wetlands. Features such as spoil bank gapping or other measures should also be added to avoid impacts to enclosed wetlands due to impaired drainage. The Corps should coordinate with the Service and other natural resource agencies to develop the best approach for avoiding drainage impacts.

5. Estimates of all direct and indirect project-related wetland impacts, including those associated with changes in freshwater inflows and distribution, should be refined during the engineering and design phase, including impacts associated with the proposed HNC Lock closures to preclude saltwater intrusion.

6. To the greatest degree practical, the hurricane protection levees and borrow pits should be located to avoid and minimize direct and indirect impacts to emergent wetlands. Efforts should be made to further reduce those direct impacts by hauling in fill material, using sheetpile for the levee crest, deep soil mixing, or other alternatives.

7. When organic soils must be removed from the construction site, that material should be used to create or restore emergent wetlands to the greatest extent practicable. If that is not practicable, then use of that material to improve borrow pit habitat quality (e.g., construct bank slopes, reduce depths, etc.) should be examined.

8. Forest clearing associated with project features should be conducted during the fall or winter to minimize impacts to nesting migratory birds, when practicable.

9. Avoid adverse impacts to bald eagle nesting locations and wading bird colonies through careful design of project features and timing of construction. Surveys prior to construction such be undertaken to ensure no nesting birds are within 1,000 feet of any proposed work. If nesting birds are found within 1,000 feet of any proposed work sites, the Service and the Louisiana Department of Wildlife and Fisheries should be contacted for procedures to avoid impacts.

10. Full, in-kind compensation (quantified as AAHUs) should be provided for unavoidable net adverse impacts on forested wetlands, marsh, and associated submerged aquatic vegetation, including any additional losses identified during

post-authorization engineering and design studies. To help ensure that the proposed mitigation features meet their goals, the Service provides the following recommendations.

a. Mitigation measures should be constructed concurrently with the features that they are mitigating.
b. The Service and other fish and wildlife conservation agencies should be consulted in the development of plans and specifications for all mitigation features and any monitoring and/or adaptive management plans.
c. Unavoidable impacts to wetlands within Mandalay National Wildlife Refuge should be mitigated on the refuge.
d. The acreage of marsh created to mitigate project impacts should meet or exceed the marsh acreage projected by the Habitat Evaluation Team for target year 5.
e. To avoid shortfalls in marsh creation acreage, the contractor should be required to guarantee the creation of at least the target acreage of marsh platform, or excess acres should be created.
f. The acreage of marsh created for mitigation purposes, and adjacent affected wetlands, should be monitored over the project life to evaluate project impacts, the effectiveness of compensatory mitigation measures, and the need for additional mitigation should those measures prove insufficient.
g. Dredged material borrow pits, including those utilized to create marsh for mitigation purposes, should be carefully designed and located to minimize anoxia problems and excessive disturbance to area water bottoms, and to avoid increased saltwater intrusion.
h. If applicable, a General Plan should be developed by the Corps, the Service, and the managing natural resource agency in accordance with Section 3(b) of the FWCA for mitigation lands.

11. Extensive additional information is needed by the Service to complete the required evaluation of project effects and fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act. Much of that information will not be available until engineering and design of the project features has progressed. To help ensure that sufficient information is provided, the Service recommends that the Corps perform the following tasks during the engineering and design phase.

a. Provide additional information on anticipated construction techniques and their associated wetland impacts, such as additional dredging to install floodgates and water control structures, dredging temporary by-pass channels, and the method for disposing organic surface soils that are unsuitable for levee construction.
b. Provide final locations and designs for borrow sites used in levee construction.

12. Sufficient funding should be provided for full Service participation in the post-authorization engineering and design studies, and to facilitate fulfillment of its

responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act.

10. The Corps should obtain a right-of-way from the Service prior to conducting any work on Mandalay National Wildlife Refuge, in conformance with Section 29.21-1, Title 50, Right-of-Way Regulations. Issuance of a right-of-way will be contingent on a determination by the Service's Regional Director that the proposed work will be compatible with the purposes for which the Refuge was established.

11. All construction or maintenance activities (e.g., surveys, land clearing, etc.) on Mandalay National Wildlife Refuge (NWR) will require the Corps to obtain a Special Use Permit from the Refuge Manager; furthermore, all activities on that NWR must be coordinated with the Refuge Manager . Therefore, we recommend that the Corps request issuance of a Special Use Permit well in advance of conducting any work on the refuge. Please contact the Refuge Manager (985/853-1078) for further information on compatibility of flood control features, and for assistance in obtaining a Special Use Permit. Close coordination by both the Corps and its contractor must be maintained with the Refuge Manager to ensure that construction and maintenance activities are carried out in accordance with provisions of any Special Use Permit issued by the NWR.

12. If mitigation lands are purchased for inclusion within a NWR those lands must meet certain requirements; a summary of some of those requirements is provided in Appendix C. Other land-managing natural resource agencies may have similar requirements that must be met prior to accepting mitigation lands; therefore, if they are proposed as a manager of a mitigation site, they should be contacted early in the planning phase regarding such requirements.

13. The Corps should contact the Louisiana Department of Wildlife and Fisheries prior to conducting any work on Point au Chene Wildlife Management Area (985-594-5494).

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

The Mississippi River and Tributaries - Morganza, Louisiana, to the Gulf of Mexico Reconnaissance Study was authorized by a resolution adopted April 30, 1992, by the Committee on Public Works and Transportation of the U.S. House of Representatives. A feasibility study was authorized via the Energy and Water Development Appropriation Act of 1995 (Public Law 103-316). That Act directed the Corps of Engineers (Corps) to give particular attention to the interrelationships of the various ongoing studies in the area, and to consider improvements for the Houma Navigation Canal (HNC). That Act also authorized the Corps to address " . . . wetland conservation and restoration, wildlife habitat, commercial and recreational fishing, saltwater intrusion and fresh water and sediment diversion . . . " in the project area.

In 2002, a Final Feasibility Study and Programmatic Environmental Impact Statement (PEIS) was completed by the Corps. In that PEIS, the Corps evaluated alternative levee alignments and selected an alignment that included over 70 miles of protection levees and included numerous floodgates and environmental water control structures. The Morganza to the Gulf project was subsequently authorized under the 2007 Water Resources Development Act (WRDA). Following Hurricane Katrina in 2005, the Corps revised its levee construction standards. Those new standards resulted in substantial construction cost increases and triggered the Section 902 (WRDA 1986) requirement for Congressional reauthorization. Consequently, the subject Post-Authorization Change (PAC) report has been prepared to quantify costs, impacts, and the feasibility of the revised Morganza to the Gulf Project. That PAC report does not re-evaluate the alternative levee designs examined under the 2002 Feasibility Study and PEIS. Instead, it examines the feasibility, costs, and impacts associated with two levee height alternatives, both of which are located on the alignment selected in the 2002 Feasibility Report. The PAC alternatives would protect against flooding from a 1% annual chance storm (100-year frequency) and a 3% annual chance storm (35-year frequency).

Like the 2002 Morganza Feasibility Study and PEIS, the PAC Report and associated EIS will also be programmatic because detailed engineering and design is not yet available for most project features and because there was insufficient time to fully assess direct, indirect, and cumulative impacts of all project features. However, the Corps has requested that levee reaches designated as F1, F2, and G1, together with the adjoining Houma Navigation Canal (HNC) Lock and the Bayou Grand Caillou Floodgate, be examined in detail typical of a feasibility study such that the PAC report will be sufficient to seek Congressional construction approval for those measures (those measures are hereafter referred to as the constructable measures).

This Coordination Act Report provides an analysis of fish and wildlife resource impacts associated with construction and operation of the two alternative plans. For project features not being prepared for Congressional approval, the impact analysis relies on estimated habitat type acreage construction impacts conducted by the interagency Habitat Evaluation Team (HET). For the constructable features (i.e., levee reaches F1, F2, and G1, the HNC Lock and the Bayou Grand Caillou Floodgate), the impact analysis utilizes the Wetland Value Assessment (WVA) methodology to more precisely assess habitat type impacts over time. For those constructable project features, this Coordination Act Report fulfills the requirements of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and when finalized would constitute the final report of the Secretary of the Interior as required by Section 2(b) of that Act. However, for the remaining project features, the information available regarding those features is not sufficient to fully evaluate effects and impacts of those features. Hence, for those features, this Coordination Act Report does not fulfill the requirements of the Fish and Wildlife Coordination Act and does not constitute the final report of the Secretary of the Interior as required by Section 2(b) of that Act.

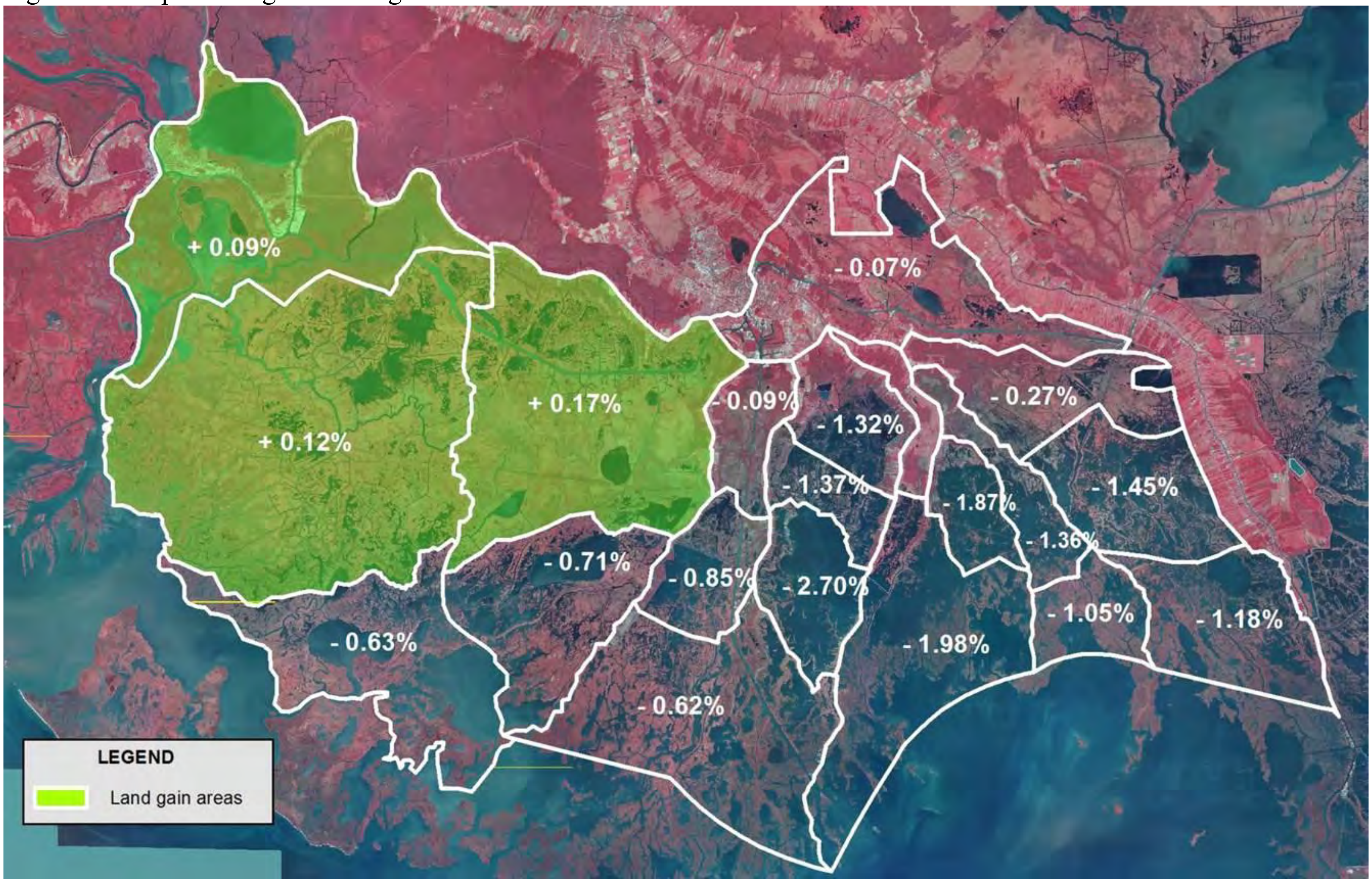
DESCRIPTION OF STUDY AREA

The study area lies between the Atchafalaya River to the west, and Bayou Lafourche to the east. This area, known as the Terrebonne Basin, is a region dominated by extensive coastal wetlands created by deltaic processes of the Mississippi River. Because of its deltaic history, the study area is characterized by a number of former distributary channels extending generally southward toward the Gulf of Mexico, with wetlands or marsh basins occurring between those distributaries. Because the highest land elevations occur on the distributary ridges, developed areas are generally located there. The interdistributary wetland basins often exhibit north-south salinity gradients with fresh or low-salinity conditions toward the north, and more saline conditions nearer the Gulf. Riverine freshwater and sediment inputs available to the study area via Bayou Terrebonne and its distributaries were largely eliminated when the head of Bayou Lafourche was damned in 1903. The elimination of the freshwater inputs and associated deltaic processes, plus the imposition of other man-made impacts, have caused much of the study area to experience rapid wetland loss. However, western portions of the study area which are receiving freshwater and sediment inputs from the Atchafalaya River are stable or have low rates of wetland loss. Additional information regarding the study area may be found in the Service's April 2002 Final Coordination Act Report on the initial Morganza to the Gulf Feasibility Study. That information is incorporated herein by reference.

FISH AND WILDLIFE CONCERNS IN THE STUDY AREA

The Terrebonne Basin has experienced more land loss (1932-2010) than any other basin in coastal Louisiana. Although recent loss rates have decreased in other portions of the state, recent loss rates remain high in the Terrebonne Basin (Couvillion et al. 2011). Recent loss rates are greatest in central and eastern portions of the study area. Conversely, the northwestern portion of the study area has experienced slight land acreage gains (Figure 1). A large portion of the central and eastern study area is predicted to lose all marsh by the beginning of the 50-year project life, and nearly all of the central and eastern Terrebonne Basin marshes will be gone by the end of the 50-year life (Figures 2 and 3, respectively) under a historic low sea level rise (SLR) rate.

Figure 1. Map showing land loss/gain rates in % of 1985 land acres*.



* *Percent loss rates are derived from 1985 – 2009 Landsat satellite imagery.*

Figure 2. Study area subunits predicted to lose all land by 2035, under the low SLR scenario.

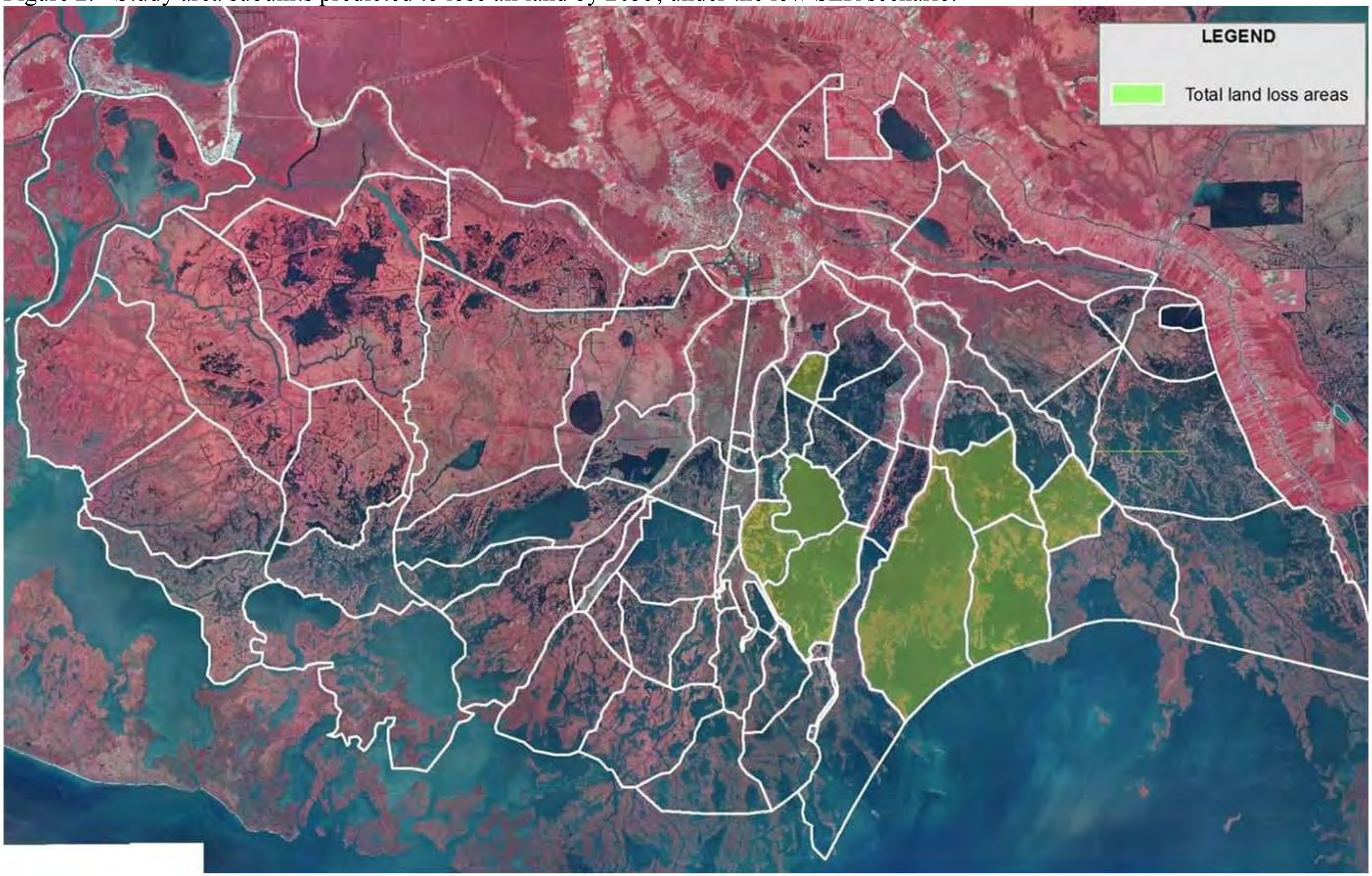
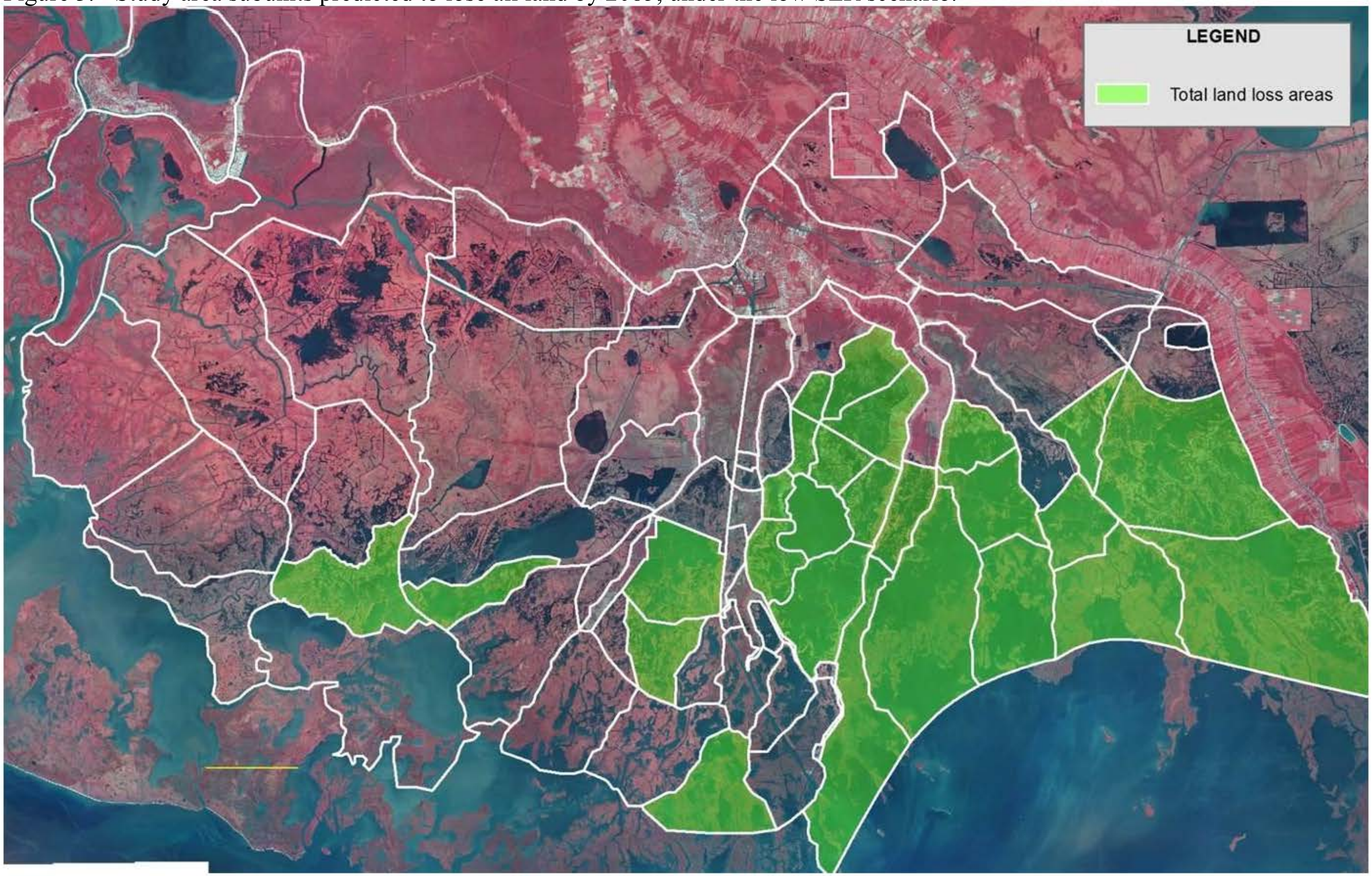


Figure 3. Study area subunits predicted to lose all land by 2085, under the low SLR scenario.



Continuing wetland loss constitutes a serious threat to the nationally important fish and wildlife resources of the study area. Associated with those wetland losses, the central and eastern Terrebonne Basin has experienced a substantial conversion of low-salinity habitat to more brackish and saline habitats (Figures 4 and 5). Atchafalaya River influence has maintained the fresh marsh habitats of the northwest Terrebonne Basin and has slowed the overall rate of wetland loss within that area.

The fresh and intermediate marsh portion of the Terrebonne Basin has been identified by the North American Waterfowl Management Plan, Gulf Coast Joint Venture, as a key waterfowl wintering area. Loss of the fresh and low salinity habitats (i.e., loss of habitat diversity) in the central and eastern Terrebonne Basin will adversely impact not only wintering waterfowl, but many other fish and wildlife species which prefer fresh and low salinity wetlands. The continued rapid loss of vegetated wetlands throughout the Terrebonne Basin will also diminish the quantity and quality of nursery habitat for estuarine-dependent fishes and shellfishes, thereby reducing the production of commercially and recreationally important species (Turner 1982).

Given the adverse impacts of continuing coastal wetland loss, the Service strongly supports strategies and projects designed to reduce or halt the continuing wetland losses. Regional Strategy 4 in the Coast 2050 Plan (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998) calls for the maintenance and enhancement of Atchafalaya River inputs to Terrebonne Basin marshes. Regional Strategy 6, the installation and operation of a lock on the lower HNC to preclude the saltwater intrusion during low flow on the Atchafalaya River, would improve the distribution of existing seasonal freshwater flows, and would help to reduce area wetland losses.

The recently released 2012 Coastal Master Plan (Louisiana Coastal Protection and Restoration Authority 2012) includes the same major strategies as does the Coast 2050 Plan. To partially implement those strategies, the Service is in the process of constructing the North Lake Boudreaux Basin Freshwater Introduction Project. That project has been funded via the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) and would benefit approximately 7,200 acres of low-salinity and brackish wetlands through the introduction and management of seasonally available Atchafalaya River flows from the GIWW and the HNC. Because Morganza floodgates and structures could potentially alter area hydrology, it is possible that the North Lake Boudreaux Project could be affected, positively or negatively.

Because of the severe marsh loss problem within the study area marshes, substantial increases in riverine freshwater and sediment inputs are needed to markedly reduce marsh loss rates. For this reason, wetland restoration strategies and projects include measures which would increase the volume of Gulf Intracoastal Waterway (GIWW) freshwater flows from the Atchafalaya River. Such measures were partially evaluated under the 2010 Louisiana Coastal Area (LCA) Ecosystem Restoration Feasibility Study (U.S. Army Corps of Engineers and Louisiana Coastal Protection and Restoration Authority 2010) and the 2012 Coastal Master Plan. Given that those measures have not been fully developed, and that those freshwater flows pass through the proposed Morganza protection system, conflicts between yet to be identified restoration measures and current designs for Morganza protection features and floodgates may be discovered. The Service

Figure 4. Study area 1968 habitat types.

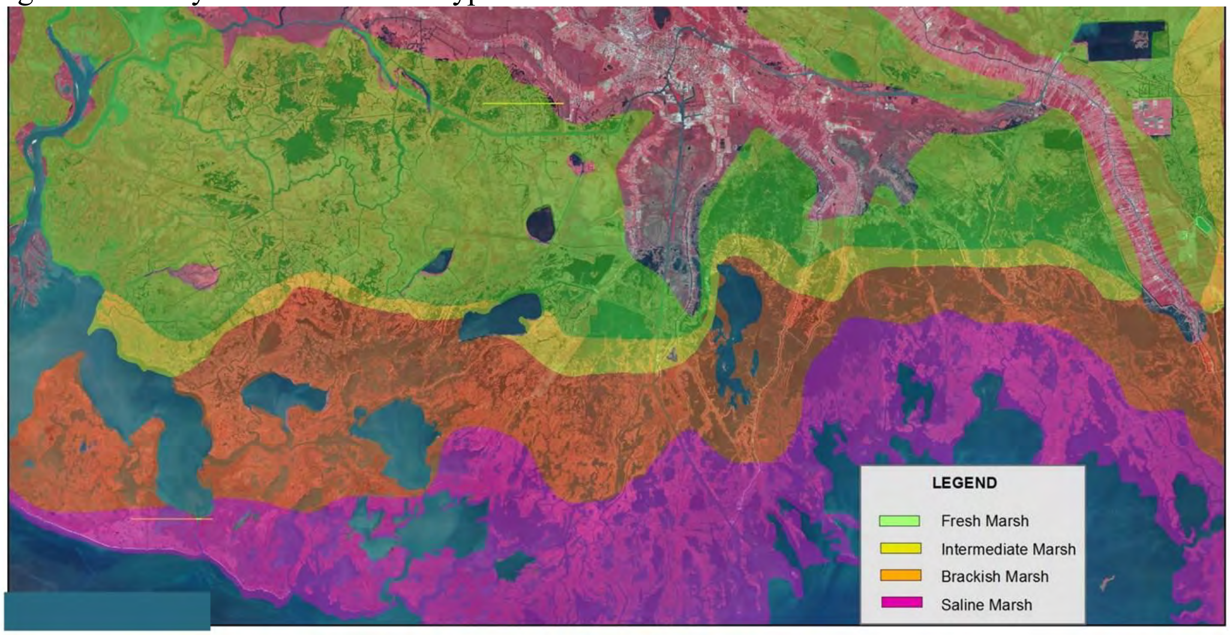
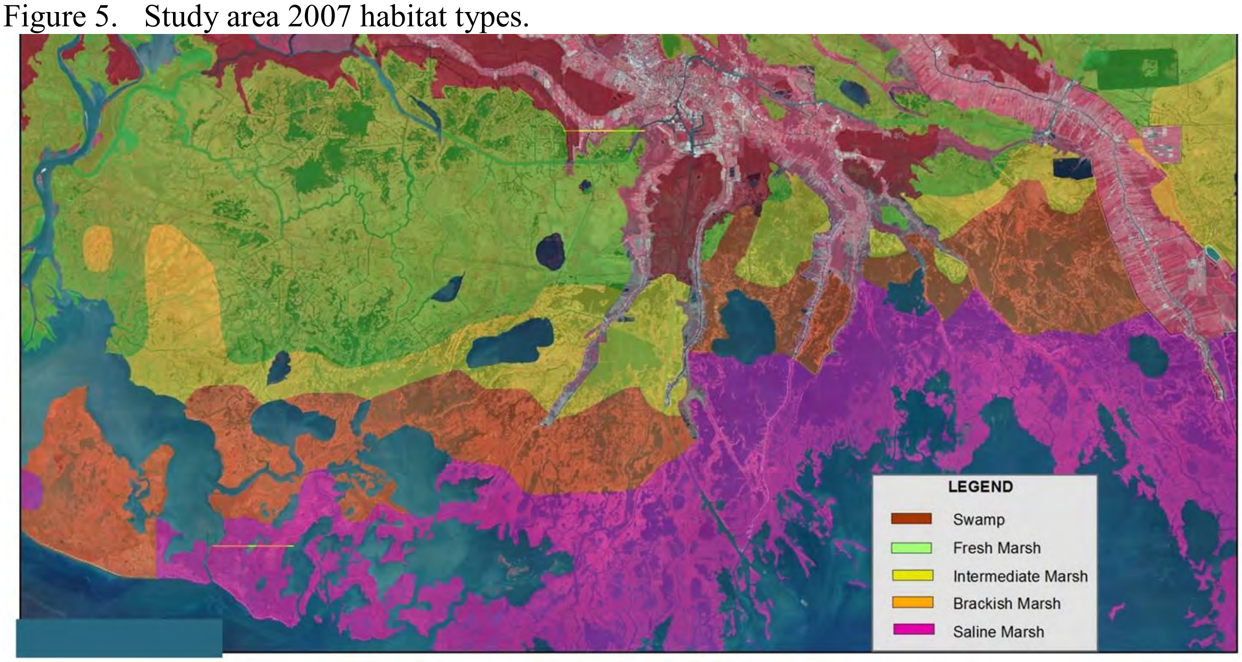


Figure 5. Study area 2007 habitat types.

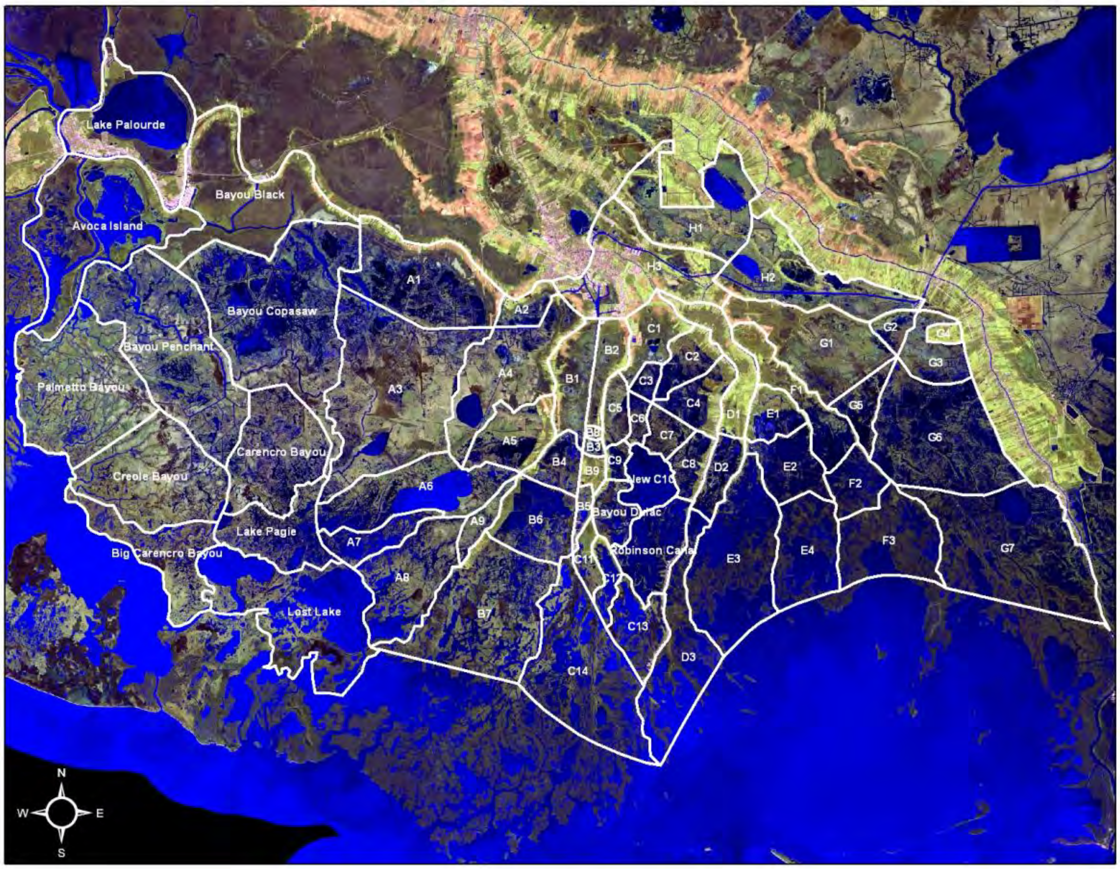


is, therefore, concerned that in the absence of concurrent and integrated protection and restoration planning, that essential restoration options may be foreclosed, or that restoration costs will be rendered prohibitively expensive because the protection measures were established first. Where final designs of Morganza protection measures have yet to be completed, the Service encourages the project sponsors and the Corps to amend Morganza plans and designs to accommodate modifications needed to facilitate restoration needs, if such needs become known. Modifications to improve the sustainability of wetlands outside of the Morganza system may provide valuable protection for the proposed levees and may reduce levee maintenance costs which are likely to increase as adjacent marshes convert to open water.

EVALUATION METHODOLOGY

The study area was divided into subunits or polygons having similar wetland loss characteristics and loss rates (Figure 6).

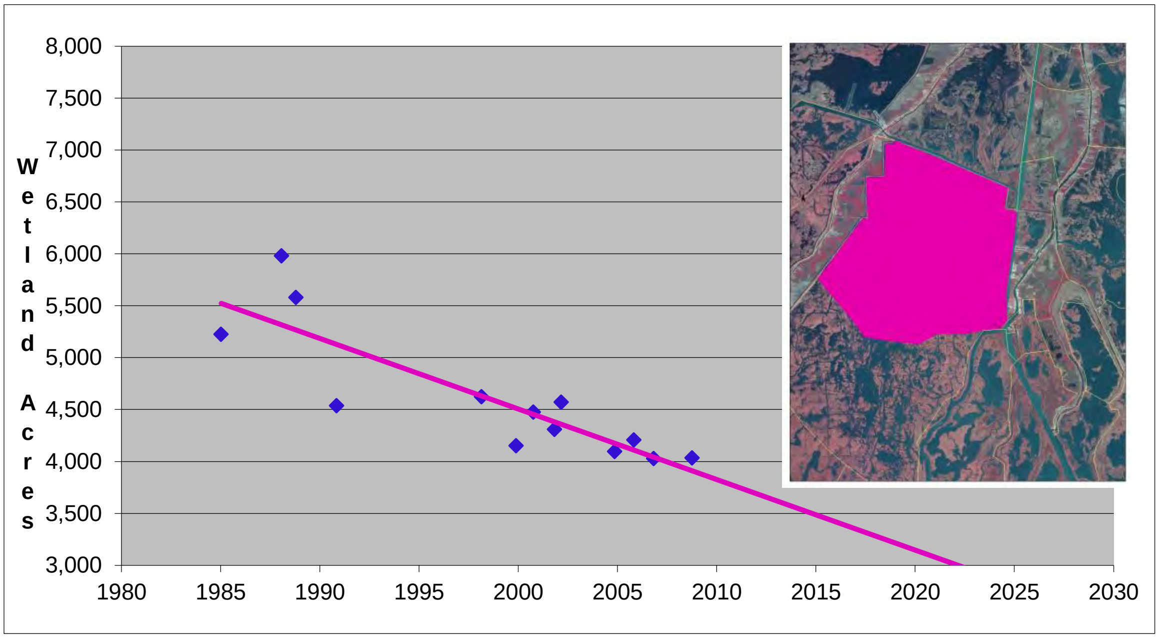
Figure 6. Map delineating the location of study area subunits.



Wetland acreage data (1985 through 2008) was obtained from the U.S. Geological Survey (USGS) from satellite imagery for each of the study area subunits. Future-without-project (FWOP) subunit marsh loss rates were determined by producing a linear trendline through the data (Figure 7) for each study area subunit. Using the trendline, marsh acreages within each study area subunit were projected from 1985 through the project life (2035 to 2085). This process applies only to coastal marshes. The conversion of forested habitats to open water or other habitat types is a much more complicated process and no simple methods are currently available to predict such habitat type changes.

The trendline projections are assumed to represent a continuation of the historic low sea level rise (SLR) scenario. However, future marsh acreages were also calculated for two additional scenarios characterized by increasing SLR.

Figure 7. Observed data points and linear trendline for marshes of subunit B13.

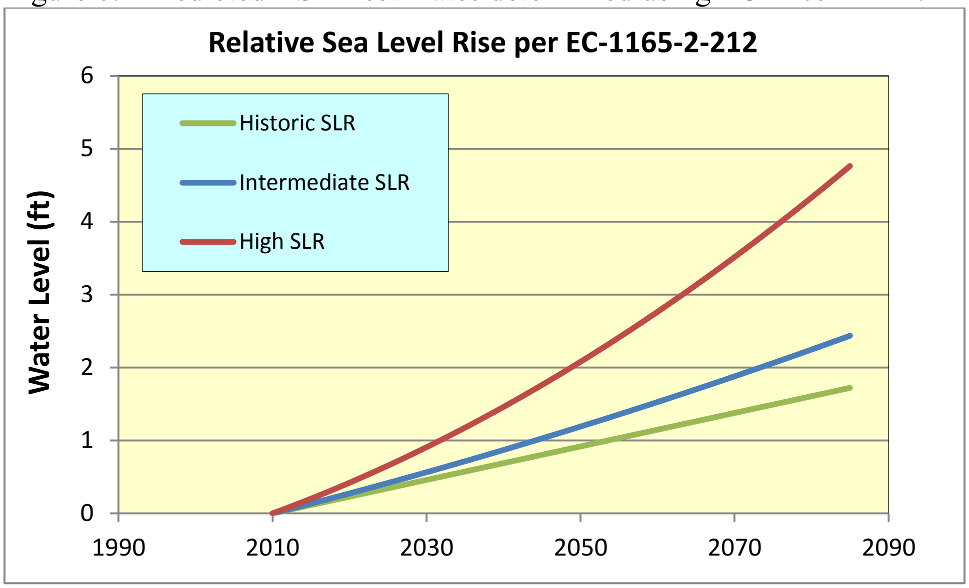


Long-term water level gage data from the Leeville, Louisiana gage was utilized per the Corps' Engineering Circular (EC) 1165-2-212 to develop relative sea level rise rates associated with low (historic), intermediate, and high sea level rise scenarios. According to EC guidance, the intermediate and high estimates of eustatic SLR were derived using the National Research Council (NRC) equations NRC I and NRC III, respectively. Based on the Leeville gage, the historic water level rise trend has been 6.995 millimeters/year (mm/yr). Subtracting the historic eustatic SLR rate of 1.7 mm/yr yields a subsidence rate of 5.295 mm/yr. By adding the subsidence rate to the predicted eustatic SLR, RSLR rates were determined for the historic (low), medium (or intermediate) and high SLR scenarios (Figure 8).

Recent wetland loss rates (1985-2008) were assumed to have occurred under a constant low or historic SLR rate. Therefore, for the low RSLR scenario (i.e., the continuation of the current 6.995 mm per year RSLR rate observed at the Leeville gage), the historic marsh loss rates were held constant and projected forward to provide yearly land acreages through the life of the project. For the intermediate and high scenarios, the 1985-2008 annual wetland loss rates for each subunit were gradually increased (beginning in 2010), by adding an additional annual increment of loss based on the SLR increase for that year. Those annual wetland loss rate increases were based on the slope of the negative relationship observed between wetland loss rates and RSLR rates from coastwide non-fresh marshes outside of active deltaic influences. In this relationship, RSLR was calculated as the sum of subsidence per statewide subsidence zones (see Figure 9) plus a eustatic

SLR rate of 1.7 mm/yr. Those land loss rates in percent per year, were plotted against RSLR determined for those subsidence zones (Figure 10). According to the slope of this wetland loss versus RSLR relationship, every 1.0 mm/yr increase in RSLR would result in a 0.11%/yr increase in the wetland loss rate. The additional RSLR related wetland loss rate was then added to the baseline or historic loss rate to obtain total annual loss rates for each year, under the increasing sea level rise scenarios.

Figure 8. Predicted RSLR estimates determined using EC 1165-2-212.



To determine the acreage of construction impacts, National Wetland Inventory (NWI) 2008 data for the study area were obtained. Using ArcMap software, that NWI data was subdivided by each levee alternative right-of-way footprint, by individual levee reach, and by the study area loss polygons. The resulting data set provided acres of direct impacts in 2008, by habitat type, by levee alternative, levee reach, and loss polygon. Because of wetland loss, wetland loss rates from study area subunits, had to be applied to the 2008 NWI marsh acreages to obtain estimates of construction impacts in the year during which construction would occur (Table 1). Because impact footprints for each lift were not available, it was assumed that the full impact would occur upon the first levee lift.

Given the tight study schedule, the Habitat Evaluation Team (HET) agreed that for levee segments not proposed for immediate construction authorization, a tabulation of impacted habitat type acres would be sufficient for a programmatic evaluation. However, a detailed evaluation of levee reaches F1, F2, G1, the HNC Lock Complex and the Bayou Grand Caillou was conducted so that those project features could be ready for authorization and construction. Accordingly, the HET decided that those features should be evaluated using the Wetland Value Assessment (WVA v1.1) methodology to assess project impacts to both habitat quantity and quality over time.

Figure 9. Coastwide subsidence zones from the Corps of Engineers.

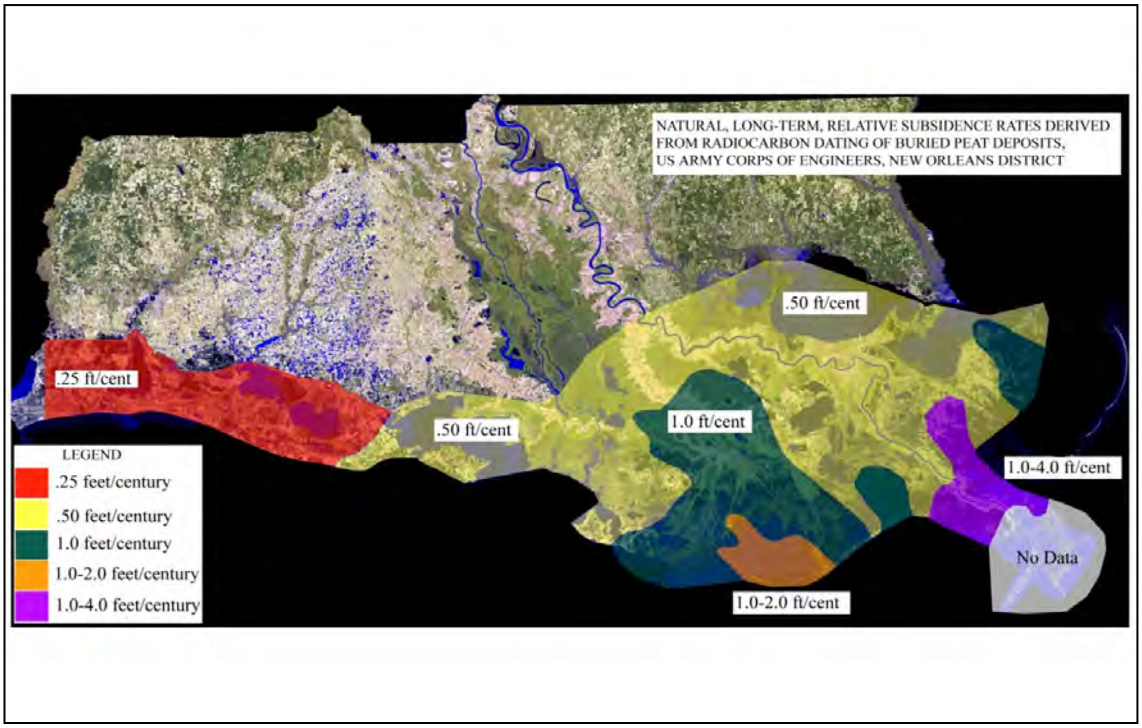


Figure 10. Coastwide wetland loss rates vs. RSLR relationship.

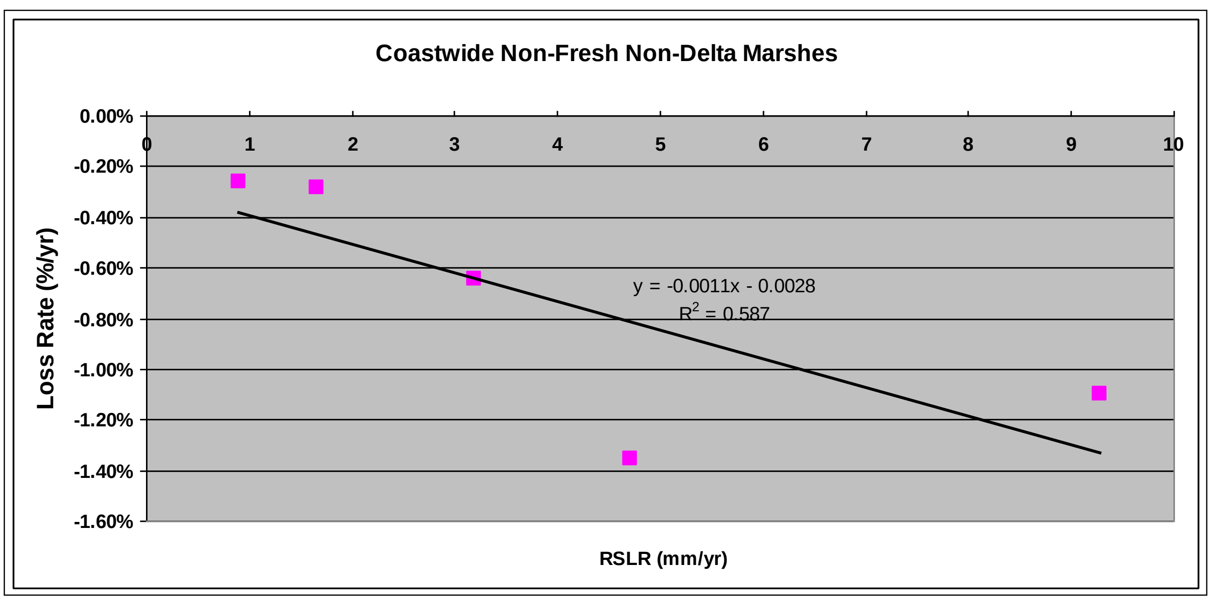


Table 1. Construction schedule for the Morganza levee alternatives.

	35-Year Levee Alt	100-Year Levee Alt
Levee Reach	First Lift Year	First Lift Year
A	2019	2015
B	2015	2015
E-1	2015	2015
E-2	2015	2015
F-1	2015	2015
F-2	2015	2015
G-1	2016	2016
G-2	2016	2016
G-3	2016	2016
H-1	2015	2015
H-2	2015	2015
H-3	2015	2015
I-1	2015	2015
I-2	2015	2015
I-3	2015	2015
J-1	2015	2015
J-2	2015	2015
J-3	2016	2016
K	2015	2015
L	2018	2016
Barrier	2020	2015

WVA Methodology

The Wetland Value Assessment (WVA) methodology was initially developed to evaluate proposed Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) projects (LCWCRTF 2012). The WVA methodology is similar to the Service's Habitat Evaluation Procedures (HEP), in that habitat quality and quantity are measured for baseline conditions and predicted for FWOP and FWP conditions. The Fresh/Intermediate Marsh Model and the Brackish Marsh Model were used for this project. Instead of the species-based approach of HEP, the WVA models use an assemblage of variables considered important to the suitability of a given habitat type for supporting a diversity of fish and wildlife species. As with HEP, the WVA allows a numeric comparison of each future condition and provides a combined quantitative and qualitative estimate of project-related impacts to fish and wildlife resources.

WVA models operate under the assumption that optimal conditions for fish and wildlife habitat within a given coastal wetland type can be characterized, and that existing or predicted conditions can be compared to that optimum to provide an index of habitat quality. Habitat quality is estimated and expressed through the use of a mathematical model developed specifically for each habitat type. Each model consists of: 1) a list of variables that are considered important in characterizing fish and wildlife habitat; 2) a Suitability Index graph for each variable, which defines the assumed relationship between habitat quality (Suitability Indices) and different variable values; and 3) a mathematical formula that combines the Suitability Indices for each variable into a single value for wetland habitat quality, termed the Habitat Suitability Index (HSI).

Emergent marsh habitat models have been developed for fresh, intermediate, brackish and saline marsh types. The habitat variable-habitat suitability relationships within those WVA models have not been verified by field experiments or validated through a rigorous scientific process. However, the variables were originally derived from HEP suitability indices taken from species models for species found in that habitat type. It should also be noted that some aspects of the WVA have been defined by policy and/or functional considerations of CWPPRA. However, habitat variable-habitat suitability relationships are, in most cases, supported by scientific literature and research findings. In other cases, best professional judgment by a team of fisheries biologists, wildlife biologists, ecologists, and university scientists may have been used to determine certain habitat variable-habitat suitability relationships. In addition, the WVA models have undergone a refinement process and habitat variable-habitat suitability relationships, HSIs, and other model aspects are periodically modified as more information becomes available regarding coastal fish and wildlife habitat suitability, coastal processes, and the efficacy of restoration projects being evaluated.

The WVA models assess the suitability of each habitat type for providing resting, foraging, breeding, and nursery habitat to a diverse assemblage of fish and wildlife species. This standardized, multi-species, habitat-based methodology facilitates the assessment of project-induced impacts on fish and wildlife resources.

The WVA marsh models consists of six variables: 1) percent of wetland area covered by emergent marsh; 2) percent open water covered by submerged aquatic vegetation; 3) marsh edge and interspersion; 4) percent of the open water area <= 1.5 feet deep; 5) salinity; and 6) aquatic organism access.

Target years were established when significant changes in habitat quality or quantity were expected during the project life, under FWP and FWOP conditions. Because construction of some levee segments would begin in 2015, and others would begin much later, a 70-year period would be required to evaluate impacts of features constructed in 2015 (through the project life which ends in 2085). Therefore, to evaluate project measures consistently, all measures were evaluated over a 70-year period.

The product of an HSI and the acreage of available habitat for a given target year is known as the Habitat Unit (HU). The HU is the basic unit for measuring project effects on fish and wildlife habitat. Future HUs change according to changes in habitat quality and/or quantity. Results are annualized over the period of analysis (i.e., 70 years) to determine the Average Annual Habitat Units (AAHUs) available for each habitat type.

The change in AAHUs for each FWP scenario, compared to FWOP project conditions, provides a measure of anticipated impacts. A net gain in AAHUs indicates that the project is beneficial to the habitat being evaluated; a net loss of AAHUs indicates that the project is damaging to that habitat type.

Construction of the proposed levee segments would replace a FWOP functional marsh with a levee and a borrow canal. Because the deep waters of navigation canals and major bayous are assumed to provide little if any habitat value, such waterbodies are typically excluded from the project area. Therefore, the HET assumed that the deep water of the FWP borrow canal would also be of little value, and hence, was excluded from the FWP project area. Since there would be no remaining habitat quantity or quality FWP, the final WVA impacts were equal to the sum of marsh + water FWOP AAHUs.

Although the WVA methodology is relatively easy to use, the study schedule did not allow for collection of field data for WVA inputs. Instead, best professional judgment (based on past site visits) was used to provide Variable 2 and Variable 4 inputs (percent submerged aquatic vegetation and percent shallow open water, respectively) necessary to the WVA. Wetland acreage predictions discussed above were used to provide V1 values. However, one WVA assessed impacts to wetlands under forced drainage along Four Pointe Bayou. Those wetlands were assumed to experience no loss throughout the 70-year evaluation period.

Salinity modeling (conducted using 2004 input data) was assumed to represent baseline and construction year salinity values. The model outputs consisted of average subunit salinities at 15 minute intervals throughout the year for FWOP and for a FWP scenario (Plan 1) with all floodgates and structures open year-round. Effects of short-term HNC Lock closures to reduce saltwater intrusion were not incorporated into the project scenarios modeled. The 15 minute salinity values were averaged as needed to provide V5 inputs. Predicted salinities under future with SLR conditions were not available within the study schedule. Hence, the HET assumed that future salinities would remain the same as in 2004. For all levee segments, FWOP fish access was assumed to be unrestricted (V6 = 1.0). FWOP WVA variables used to assess direct impacts and potential mitigation measures are listed in Appendix A, Tables A-1, A-2, and A-3.

Indirect Impacts WVAs

In addition to direct construction impacts, project implementation might alter the hydroperiod, salinity, and fish access to enclosed wetlands. The HET examined hydrologic model results regarding project-induced water level changes. There was little if any such change, and the HET assumed that those changes were not significant. Consequently, the HET did not attempt to assess impacts associated with project-induced changes in hydroperiod.

The HET also examined predicted salinity changes for subunits inside and outside the levee system. Because FWP salinities did not include the anticipated short-term HNC Lock closures to provide saltwater intrusion protection, the HET merged salinity outputs from a model run where the Lock was closed year-round (Plan 3) with Plan 1 outputs (all gates open year-round) to create a Modified Plan 1 salinity output. Due to widely varying estimates of Lock closure duration, substantial uncertainty regarding Modified Plan 1 salinities, and the relatively minor change in predicted Modified Plan 1 salinities (which used a liberal estimate of lock closure duration), the HET decided that project-induced salinity reductions were too uncertain to quantify at this time. Predicted salinity increases were noted for marshes south of the Lock, during lock closure periods. However, the salinities remained within the optimal range according to WVA models. As a result, the HET decided not to assess benefits or impacts associated with project-induced salinity increases or decreases.

Because all Morganza floodgates and environmental structures would be closed only upon approach of a tropical storm, fisheries access interruptions would occur on average roughly 1 or 2 days per year. However, the duration of HNC Lock closures to reduce saltwater intrusion would likely be greater, and could result in quantifiable fish access interruptions. However, there were substantial uncertainties regarding the duration of lock closures. Additionally, effects of HNC Lock closures would potentially be reduced because the adjoining Bayou Grand Caillou floodgate would remain open to provide fish access. Lacking more definitive information on project-induced water exchange flux, the HET decided that the uncertainties were too great to propose project-induced reductions in fisheries access. As a result of its evaluations, the HET decided not to quantify any indirect impacts or indirect benefits associated with project implementation due to hydrology changes or fisheries access reductions.

Mitgation WVAs.

To compensate for marsh losses associated with construction of levee reaches F1, F2, G1, the HNC Lock, and the Bayou Grand Caillou Floodgate, the HET evaluated several marsh creation projects under the medium SLR scenario. Construction impacts to fresh and intermediate marshes would be mitigated by marsh creation in the intermediate marshes of subunit B13 (open water areas south of Falgout Canal). Construction impacts to brackish marshes would be mitigated via marsh creation in the Felix Lake area (subunit B15 open water area immediately west of the HNC Lock). WVA variables used to quantify benefits of proposed marsh creation measures are provided in Appendix A, Table A-3.

EXISTING FISH AND WILDLIFE RESOURCES

Description of Habitats

Study area fish and wildlife habitats include bottomland hardwood forests, cypress-tupelo swamp, shrub scrub, fresh, intermediate, brackish, and saline marshes, and open water areas within the prior-mentioned zones. More information on those habitats is available in the Service's April 2002 Fish and Wildlife Coordination Report and is herein included by reference.

Fishery Resources

Wetlands throughout the study area abound with small resident fishes and shellfishes such as least killifish, rainwater killifish, sheepshead minnow, mosquitofish, sailfin molly, grass shrimp, and others. Those species are typically found along marsh edges and among submerged aquatic vegetation, and provide forage for a variety of fish and wildlife. Fresh water and low-salinity marshes provide habitat for commercially and recreationally important resident freshwater fishes such as largemouth bass, yellow bass, black crappie, bluegill, redear sunfish, warmouth, blue catfish, channel catfish, buffalo, freshwater drum, bowfin, and gar. Areas supporting stable freshwater fisheries occur in the northwestern and northeastern portions of the study area. Freshwater fishes may also utilize low-salinity areas (intermediate marsh zone), provided they have access to fresher areas during periods of high salinity.

The coastal marshes also provide nursery habitat for many estuarine-dependent commercial and recreational fishes and shellfishes. Because of the protection and abundant food afforded by those wetlands, they are essential to the growth and production of species such as blue crab, white shrimp, brown shrimp, Gulf menhaden, Atlantic croaker, red drum, spotted seatrout, black drum, sand seatrout, spot, southern flounder, striped mullet, and others. Those species are generally most abundant in the brackish and saline marshes; however, blue crab, Gulf menhaden, and Atlantic croaker and several other species also utilize fresh and low-salinity marshes.

Because tidal marshes provide essential nursery habitat, commercial shrimp harvests are positively correlated with the area of tidal emergent wetlands, not open water area (Turner 1977 and 1982). Future commercial harvests of shrimp and other fishes and shellfishes could be adversely impacted by the high rates of marsh loss throughout the study area (Turner 1982).

The American oyster occurs throughout much of the brackish and saline marsh zones within the study area. Oyster harvesting constitutes a valuable fishery in the northern portions of that zone, where salinities range from 10 to 15 parts per thousand (ppt).

Essential Fish Habitat

The project site is located in an area that has been identified as essential fish habitat (EFH) for various life stages of federally managed species, including postlarval and juvenile life stages of brown shrimp, white shrimp, and red drum. Categories of EFH in the project area include mud and shell substrates, submerged aquatic vegetation, estuarine water column, and estuarine emergent wetlands. Detailed information on federally managed fisheries and their EFH is provided in the 2005 generic amendment of the Fishery Management Plans for the Gulf of Mexico prepared by the Gulf of Mexico Fishery Management Council. The generic amendment was prepared as required by the Magnuson-Stevens Fishery Conservation and Management Act (P.L. 104-297).

In addition to being designated as EFH for brown shrimp, white shrimp, and red drum, wetlands in the project area provide nursery and foraging habitats supportive of a variety of economically-important marine fishery species, including spotted seatrout, sand seatrout, southern flounder, black drum, gulf menhaden, and blue crab. Some of these species serve as prey for other fish species managed under the Magnuson-Stevens Act by the Gulf of Mexico Fishery Management Council (e.g., mackerels, snappers, and groupers) and highly migratory species managed by NMFS (e.g., billfishes and sharks). These wetlands also produce nutrients and detritus, important components of the aquatic food web, which contribute to the overall productivity of the Terrebonne and Timbalier Bay estuaries.

Wildlife Resources

Numerous species of birds utilize study-area marshes, including large numbers of migratory waterfowl which winter there. Project-area fresh and intermediate marshes provide excellent wintering habitat for migratory waterfowl, especially puddle ducks. For this reason, the North American Waterfowl Management Plan’s Gulf Coast Joint Venture has recognized this area, the Terrebonne Unit (which includes fresh and intermediate marshes in this study area), as a key waterfowl wintering area. Brackish marshes having abundant submerged aquatic vegetation may also support large numbers of puddle ducks. Puddle ducks that occur in the study area include mallard, gadwall, northern pintail, blue-winged teal, green-winged teal, American widgeon, wood duck, and northern shoveler. The resident mottled duck also utilizes project-area coastal marshes. Diving ducks prefer larger ponds, lakes, and open water areas. Common diving duck species include lesser scaup, canvasback, redhead, ring-necked duck, red-breasted merganser, and hooded merganser. The lesser snow goose and the white-fronted goose also utilize coastal marshes. Other migratory game birds found in coastal marshes include the king, clapper, Virginia, and sora rails along with the American coot, common moorhen, and common snipe.

Marshes and associated shallow open water areas provide habitat for a number of wading birds, shorebirds, seabirds, and other nongame birds. Common wading birds include the little blue heron, great blue heron, green-backed heron, yellow-crowned night heron, black-crowned night heron, great egret, snowy egret, cattle egret, white-faced ibis, white ibis, and roseate spoonbill. Shorebirds include the killdeer, American avocet, black-necked stilt, common snipe, and various species of sandpipers. Seabirds include white pelican, brown pelican, black skimmer, herring gull, laughing gull, and several species of terns. Ten wading and seabird nesting colonies were documented in the study area during a recent nesting bird survey (U.S. Geological Survey 2001). Other nongame birds such as boat-tailed grackle, red-winged blackbird, seaside sparrow, northern harrier, belted kingfisher, and sedge wren also utilize coastal areas.

Common mammals occurring in the coastal marshes include nutria, muskrat, mink, river otter, raccoon, swamp rabbit, white-tailed deer, and coyote.

Reptiles are most abundant in fresh and low-salinity coastal wetlands. Common species include the American alligator, western cottonmouth, water snakes, mud snake, speckled kingsnake, ribbon snakes, rat snakes, red-eared turtle, common snapping turtle, alligator snapping turtle, mud turtles, and softshell turtles. Amphibians commonly found in the area include the bullfrog, pig frog, bronze frog, leopard frog, cricket frogs, tree frogs, chorus frogs, three-toed amphiuma, sirens, and several species of toads. In brackish and saline marshes, reptiles are limited primarily to the American alligator and the diamond-backed terrapin, respectively.

Forested wetlands and scrub-shrub areas provide habitats for songbirds such as the mockingbird, yellow-billed cuckoo, northern parula, yellow-rumped warbler, prothonotary warbler, white-eyed vireo, Carolina chickadee, and tufted titmouse. Additionally, these areas also provide important resting and feeding areas for songbirds migrating across the Gulf of Mexico. Other avian species found in forested wetlands include the American woodcock, common flicker, brown thrasher, white-eyed vireo, belted kingfisher, pileated woodpecker, red-headed woodpecker, downy woodpecker, common grackle, and common crow. Numerous other bird species use forested wetlands throughout the study area.

Forested habitats and associated waterbodies also support raptors such as the red-tailed hawk, red-shouldered hawk, Mississippi kite, northern harrier, screech owl, great horned owl, and barred owl. Wading bird colonies typically occur in cypress swamp and scrub-shrub habitat. Species found in those nesting colonies include great egret, white ibis, black-crowned night heron, tricolored heron, little blue heron, snowy egret, white-faced ibis, and glossy ibises. Waterfowl species found in forested wetlands and adjacent waterbodies in the project area include, but are not limited to, wood duck, mallard, green-winged teal, gadwall, and hooded merganser.

Game mammals associated with forested wetlands include eastern cottontail, swamp rabbit, gray and fox squirrels, and white-tailed deer. Commercially important fur bearers include river otter, muskrat, nutria, mink, and raccoon. Other mammals found in forested wetlands include striped skunk, coyote, Virginia opossum, bobcat, armadillo, gray fox, and red bat. Smaller mammal species serve as forage for both mammalian and avian carnivores and include the cotton rat, marsh rice rat, white-footed mouse, eastern wood rat, harvest mouse, least shrew, and southern flying squirrel.

Reptiles which utilize study area bottomland hardwoods, cypress swamps, and associated shallow water include the American alligator, ground skink, five-lined skink, broad-headed skink, green anole, Gulf coast ribbon snake, yellow-bellied water snake, speckled kingsnake, southern copperhead, western cottonmouth, pygmy rattlesnake, broad-banded water snake, diamond-backed water snake, spiny softshell turtle, red-eared turtle, southern painted turtle, Mississippi mud turtle, stinkpot, common and alligator snapping turtle, in addition to numerous other species.

Some of the amphibians believed to be in study-area forested wetlands include dwarf salamander, three-toed amphiuma, lesser western siren, central newt, Gulf coast toad, eastern narrow-mouthed toad, green treefrog, squirrel treefrog, pigfrog, bullfrog, southern leopard frog, bronze frog, upland chorus frog, southern cricket frog, and spring peeper.

Most developed areas provide low-quality wildlife habitat. Sites developed for agricultural purposes are located on low ridges and on lower elevation areas that have improved drainage. In agricultural areas, wildlife habitat is primarily provided by unmaintained ditch banks and field edges, fallow fields, pasture lands, and rainfall-flooded fields. Cultivated crops can provide forage for some wildlife species. Game species that utilize agricultural lands include the white-tailed deer, mourning dove, bobwhite quail, eastern cottontail, and common snipe. Seasonally flooded cropland and fallow fields may provide important feeding habitat for wintering waterfowl, wading birds, and other waterbirds.

Threatened and Endangered Species

Current Federally listed threatened and endangered species, their critical habitat, that may be found in or near the study area include the West Indian manatee (*Trichechus manatus*), the piping plover (*Charadrius melodus*) and its critical habitat, the pallid sturgeon (*Scaphirhynchus albus*), Gulf sturgeon (*Acipenser oxyrhynchus desotoi*), and 5 species of sea turtles.

In accordance with Section 7(c) of the Endangered Species Act, the Corps must prepare a biological assessment to determine the effects of the recommended plan on the above-mentioned species. That biological assessment should be completed and submitted to this office prior to initiating construction or operation of proposed project features

If the Corps determines that the proposed work may affect any listed species, the Corps must request, in writing, a formal consultation from this office pursuant to Section 7(a) of the Endangered Species Act. A request to initiate formal consultation can accompany submission of the biological assessment to the Service. In keeping with the consultation requirements of the Endangered Species Act (ESA), informal and formal (if needed) consultation must be completed before the Record of Decision for these tier-off projects can be signed.

Species of Special Interest

Bald Eagle

The project-area forested wetlands provide nesting habitat for the bald eagle (*Haliaeetus leucocephalus*), which was officially removed from the List of Endangered and Threatened Species on August 8, 2007. There are numerous active bald eagle nests known to exist within the northwestern portion of the study area. New nests may also be present that are not currently listed in the database maintained by the Louisiana Department of Wildlife and Fisheries.

Bald eagles nest in Louisiana from October through mid-May. Eagles typically nest in mature trees (e.g., bald cypress, sycamore, willow, etc.) near fresh to intermediate marshes or open water in the southeastern Parishes. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants (i.e., organochlorine pesticides and lead).

Breeding bald eagles occupy "territories" that they will typically defend against intrusion by other eagles, and that they likely return to each year. A territory may include one or more alternate nests that are built and maintained by the eagles, but which may not be used for nesting in a given year. Potential nest trees within a nesting territory may, therefore, provide important alternative bald eagle nest sites. Bald eagles are vulnerable to disturbance during courtship, nest building, egg laying, incubation, and brooding. Disturbance during this critical period may lead to nest abandonment, cracked and chilled eggs, and exposure of small young to the elements. Human activity near a nest late in the nesting cycle may also cause flightless birds to jump from the nest tree, thus reducing their chance of survival.

Although the bald eagle has been removed from the List of Endangered and Threatened Species, it continues to be protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act (BGEPA). The Service developed the National Bald Eagle Management (NBEM) Guidelines to provide landowners, land managers, and others with information and recommendations to minimize potential project impacts to bald eagles, particularly where such impacts may constitute "disturbance," which is prohibited by the BGEPA. A copy of the NBEM Guidelines is available at: http://www.fws.gov/southeast/es/baldeagle/NationalBaldEagleManagementGuidelines.pdf. Those guidelines recommend: (1) maintaining a specified distance between the activity and the nest (buffer area); (2) maintaining natural areas (preferably forested) between the activity and nest trees (landscape buffers); and (3) avoiding certain activities during the breeding season. On-site personnel should be informed of the possible presence of nesting bald eagles within the project boundary, and should identify, avoid, and immediately report any such nests to this office. If a bald eagle nest is discovered within or adjacent to the proposed project area, then an evaluation must be performed to determine whether the project is likely to disturb nesting bald eagles. That evaluation may be conducted on-line at: http://www.fws.gov/southeast/es/baldeagle. Following completion of the evaluation, that website will provide a determination of whether additional consultation is necessary. A copy of that determination should be provided to this office.

Brown Pelican

Although the brown pelican has been removed from the List of Endangered and Threatened Species, brown pelicans and their nests continue to be protected under the Migratory Bird Treaty Act. To minimize disturbance to nesting colonies of brown pelicans, all activity occurring within 2,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 15 through March 31).

Colonial Nesting Birds

The proposed project would be located in an area where colonial nesting waterbirds may be present. Colonies may be present that are not currently listed in the database maintained by the Louisiana Department of Wildlife and Fisheries. That database is updated primarily by monitoring the colony sites that were previously surveyed during the 1980s. Until a new, comprehensive coast-wide survey is conducted to determine the location of newly-established nesting colonies, we recommend that a qualified biologist inspect the proposed work site for the presence of undocumented nesting colonies during the nesting season. To minimize disturbance to colonial nesting birds, the following restriction on activity should be observed:

For colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15, exact dates may vary within this window depending on species present).

In addition, we recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and their nests, and should avoid affecting them during the breeding season.

Refuges and Wildlife Management Areas
Mandalay National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service, is located within the northwest portion of the study area in the vicinity of Lake Hatch. Refuge marshes would not be enclosed within the proposed hurricane protection levees. Pointe au Chene Wildlife Management Area, managed by the Louisiana Department of Wildlife and Fisheries, is located in the eastern portion of the study area; it extends from Bayou Terrebonne eastward to the existing hurricane protection levee along Bayou Lafourche and includes marshes east of Bayou Pointe au Chene that would be enclosed by the proposed hurricane protection levee.

FUTURE WITHOUT-PROJECT FISH AND WILDLIFE RESOURCES

Western study-area fresh marshes in the Bayou Penchant area will likely receive increasing amounts of fresh water, nutrients, and sediments as the Atchafalaya River delta matures. The fresh marsh zone may increase at the expense of brackish marsh, as the area influenced by river water continues to expand. Those fresh marshes will likely remain stable until the loss of the protecting tidal marshes and ridges south of the fresh marsh zone allows for increased saltwater intrusion and tidal exchange to begin adversely impacting those formerly fresh marshes. At that time, losses of the formerly stable fresh marsh area will begin and habitat quality will begin to decrease. Tidal marshes in the Lost Lake, Jug Lake, and Lake Decade areas, although receiving seasonal Atchafalaya River influence, will continue to deteriorate. Accordingly, habitat quality for fish and wildlife will also decrease. Extensive beds of submerged aquatic vegetation may continue to provide nursery habitat for estuarine-dependent fisheries and offset marsh loss impacts until the collapsing system can no longer sustain those beds.

Wildlife habitat quality will remain high in the stable northwestern study area marshes and will increase where brackish marshes are converted to fresher habitats. Otherwise, wildlife habitat quality in the tidal non-fresh marshes will likely decrease as those marshes gradually deteriorate and convert to open water. Atchafalaya River freshwater influence in this area will sustain high production of estuarine-dependent fishery species which are tolerant of fresh water and low salinities, such as white shrimp, blue crab, Gulf menhaden, and red drum. Once these areas begin to degrade, brown shrimp habitat quantity and quality will likely begin to increase.

The rapid loss of central and eastern study area marshes will convert almost the entire area to open water by the end of the project life. Concurrently, isohalines will move northward, converting fresh and intermediate marshes adjacent to and north of the GIWW, into brackish marshes. Much of those converted marshes will not survive as brackish marsh because of their deep unconsolidated organic soil characteristics. As these marsh areas become part of Terrebonne and Timbalier Bay, habitat quality for all species of fish and wildlife will dramatically decrease.

DESCRIPTION OF ALTERNATIVE PLANS

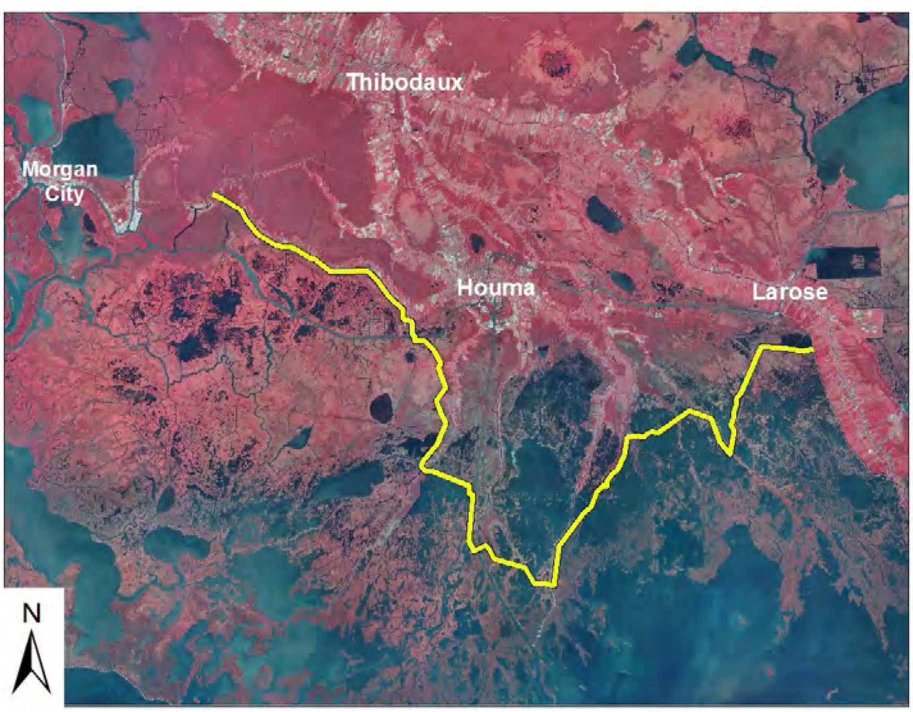
Two alternative plans were evaluated. One plan, would protect against flooding associated with a 35-year frequency event storm. The other alternative would protection against the surge of a 100-year frequency storm event. The location/alignment of both plans is the same. Therefore, the indirect impacts for both plans is identical. The impacts of the plans differ only in the greater footprint associated with the higher levees of the 100-yr frequency alternative (Figure 11). Both plans include adjacent borrow for certain sections of levee. Adjacent borrow sites are the same for both alternatives. Levee reaches not constructed using adjacent borrow, would be constructed using hauled in material. Designated levee reaches are the same for both alternative plans.

EVALUATION OF ALTERNATIVE PLANS

Because the 100-year alternative is the only alternative with a positive benefit to cost ratio, the Corps has chosen the 100-year protection alternative as the Tentatively Selected Plan.

Acreage of wetland habitat impacts were developed from right-of-way shapefiles by levee reach, for each levee alternative (Table 2) and include adjacent borrow impacts as well as levee construction impacts. Total wetland impacts under the intermediate SLR scenario for the 35-year and 100-year levee alternatives would be approximately 2,878 acres and 3,717 acres, respectively.

Figure 11. Map illustrating the location of the proposed levees.



Direct construction impacts by marsh type and by levee reach, for each SLR scenario, are provided in Appendix B. For the constructable features (reaches F1, F2, G1, the HNC Lock and the Bayou Grand Caillou Floodgate), direct construction impacts are predominantly to intermediate and brackish marshes. Under the intermediate SLR scenario, total marsh impacts associated with the constructable features for the 35-year and 100-year levees are 536 and 670 acres, respectively (Table 3). Construction impacts in AAHUs, were calculated by habitat type only for the constructable features (Table 4). Under the intermediate SLR scenario, construction of those features would result in the loss of approximately 36 and 39 intermediate marsh AAHUs, for the 35-year and 100-year alternatives, respectively. Similarly, there would be a loss of 283 and 351 AAHUs, of brackish marsh impacts due to construction of the 35-year and 100-year alternatives, respectively.

A hydrologic model was used to determine FWOP salinities and salinities under several FWP gate operation regimes. Because Morganza floodgates and structures would be closed only to preclude storm surge flooding, the gates normally would remain open. Model-predicted changes in average annual subunit salinity, calculated as FWP all gates open (designated as Plan 1) minus FWOP, were generally minor (Figure 12). The most significant change was that within the Pointe au Chene Wildlife Management Area's Grand Bayou Unit, a managed marsh impoundment. The increase would be due to increased tidal exchange with the relatively saline adjoining waters. The other notable salinity changes would be the salinity reductions due to the proposed Falgout Canal environmental structures which would discharge freshwater southward during periods of high to moderate Atchafalaya River discharge when freshwater often occurs within the HNC. Operation of the Falgout Canal structures would also preclude northward saltwater intrusion. Of lesser significance is the project–induced salinity increase throughout the Lake Boudreaux Basin. Those slight increases may be related either to reduced freshwater availability in response to discharges via the Falgout Canal structures, lesser freshwater influence via Bayou Dulac, or both.

Salinities associated with the Plan 1 model run do not accurately represent anticipated project effects as they do not include effects of HNC Lock closures to preclude saltwater intrusion. According to criteria contained in the 2002 PEIS, the lock would be closed whenever Atchafalaya River discharge was 100,000 cubic feet per second (cfs) or less, and salinity at the HNC Dulac pontoon bridge was 7.5 parts per thousand (ppt) or greater. Using all available data (April 1992 through June 2011) from the USGS gage at this location, the HET determined that such conditions occur 4.6% of the time (under FWOP conditions). However, model-predicted Plan 1 subunit B5 average salinities exceeding 7.5 ppt, occurring for at least a 24-hour duration, occurred 15.6% of the year. Given that model results were based upon observed inputs for 2004, the model results lack the range of environmental and river discharge conditions expected to occur. Therefore, the gage-observed salinities should give a better estimate of potential Lock closure duration assuming that the project floodgates open year-round do not significantly change area hydrology and modeling suggests that this is the case.

Table 2. Construction impacts by levee reach and SLR scenario.

Low SLR Scenario				Intermediate SLR Scenario				High SLR Scenario			
35-Yr Levees	Hwds (acres)	Swamp (acres)	Marsh (acres)	35-Yr Levees	Hwds (acres)	Swamp (acres)	Marsh (acres)	35-Yr Levees	Hwds (acres)	Swamp (acres)	Marsh (acres)
Barrier	170	475	157	Barrier	170	475	157	Barrier	170	475	156
A	65	51	306	A	65	51	305	A	65	51	303
B	0	0	130	B	0	0	130	B	0	0	130
E-1	0	0	56	E-1	0	0	56	E-1	0	0	56
E-2	0	0	9	E-2	0	0	9	E-2	0	0	9
F-1	0	0	291	F-1	0	0	291	F-1	0	0	290
F-2	0	0	120	F-2	0	0	120	F-2	0	0	119
G-1	0	0	125	G-1	0	0	125	G-1	0	0	124
G-2	0	0	29	G-2	0	0	29	G-2	0	0	28
G-3	0	0	33	G-3	0	0	33	G-3	0	0	33
H-1	0	0	83	H-1	0	0	83	H-1	0	0	83
H-2	0	0	138	H-2	0	0	138	H-2	0	0	138
H-3	0	0	74	H-3	0	0	74	H-3	0	0	73
I-1	0	0	75	I-1	0	0	75	I-1	0	0	75
I-2	0	0	66	I-2	0	0	66	I-2	0	0	66
I-3	0	0	69	I-3	0	0	69	I-3	0	0	69
J-1	0	0	42	J-1	0	0	42	J-1	0	0	41
J-2	0	0	68	J-2	0	0	68	J-2	0	0	67
J-3	0	0	18	J-3	0	0	18	J-3	0	0	17
K	0	0	89	K	0	0	89	K	0	0	89
L	0	0	142	L	0	0	142	L	0	0	141
TOTAL	235	526	2,119	TOTAL	235	526	2,117	TOTAL	235	526	2,108

Low SLR Scenario				Intermediate SLR Scenario				High SLR Scenario			
100-Yr Levees	Hwds (acres)	Swamp (acres)	Marsh (acres)	100-Yr Levees	Hwds (acres)	Swamp (acres)	Marsh (acres)	100-Yr Levees	Hwds (acres)	Swamp (acres)	Marsh (acres)
Barrier	202	547	209	Barrier	202	547	209	Barrier	202	547	208
A	81	13	362	A	81	13	361	A	81	13	361
B	0	0	182	B	0	0	182	B	0	0	182
E-1	0	0	94	E-1	0	0	94	E-1	0	0	94
E-2	0	0	39	E-2	0	0	39	E-2	0	0	39
F-1	0	0	359	F-1	0	0	359	F-1	0	0	358
F-2	0	0	147	F-2	0	0	147	F-2	0	0	146
G-1	0	0	165	G-1	0	0	165	G-1	0	0	164
G-2	0	0	53	G-2	0	0	53	G-2	0	0	52
G-3	0	0	43	G-3	0	0	43	G-3	0	0	43
H-1	0	0	112	H-1	0	0	112	H-1	0	0	112
H-2	0	0	187	H-2	0	0	186	H-2	0	0	186
H-3	0	0	103	H-3	0	0	102	H-3	0	0	102
I-1	0	0	83	I-1	0	0	83	I-1	0	0	83
I-2	0	0	86	I-2	0	0	86	I-2	0	0	86
I-3	0	0	91	I-3	0	0	90	I-3	0	0	90
J-1	0	0	84	J-1	0	0	84	J-1	0	0	83
J-2	0	0	103	J-2	0	0	103	J-2	0	0	103
J-3	0	0	26	J-3	0	0	26	J-3	0	0	25
K	0	0	139	K	0	0	139	K	0	0	138
L	0	0	212	L	0	0	212	L	0	0	212
TOTAL	282	560	2,877	TOTAL	282	560	2,874	TOTAL	282	560	2,867

Table 3. Summary of wetland impacts for constructable features.

35-year Levees - Low SLR Scenario				35-Year Levees - Intermediate SLR Scenario				35-Year Levees - High SLR Scenario			
35-Yr Levees	Intermediate Marsh (acres)	Brackish Marsh (acres)	TOTAL Marsh (acres)	35-Yr Levees	Intermediate Marsh (acres)	Brackish Marsh (acres)	TOTAL Marsh (acres)	35-Yr Levees	Intermediate Marsh (acres)	Brackish Marsh (acres)	TOTAL Marsh (acres)
F1	75	217	291	F1	75	217	291	F1	74	216	290
F2	120	0	120	F2	120	0	120	F2	119	0	119
G1*	14	111	125	G1*	14	111	125	G1*	14	110	124
TOTAL	208	328	536	TOTAL	208	327	536	TOTAL	208	326	534

100-year Levees - Low SLR Scenario				100-Year Levees - Intermediate SLR Scenario				100-Year Levees - High SLR Scenario			
35-Yr Levees	Intermediate Marsh (acres)	Brackish Marsh (acres)	TOTAL Marsh (acres)	35-Yr Levees	Intermediate Marsh (acres)	Brackish Marsh (acres)	TOTAL Marsh (acres)	35-Yr Levees	Intermediate Marsh (acres)	Brackish Marsh (acres)	TOTAL Marsh (acres)
F1	84	276	359	F1	84	276	359	F1	83	275	358
F2	147	0	147	F2	147	0	147	F2	146	0	146
G1*	26	139	165	G1*	26	139	165	G1*	26	138	164
TOTAL	257	414	671	TOTAL	256	414	670	TOTAL	255	413	669

* *G1 intermediate marsh acreage is fresh marsh enclosed within a forced drainage area*

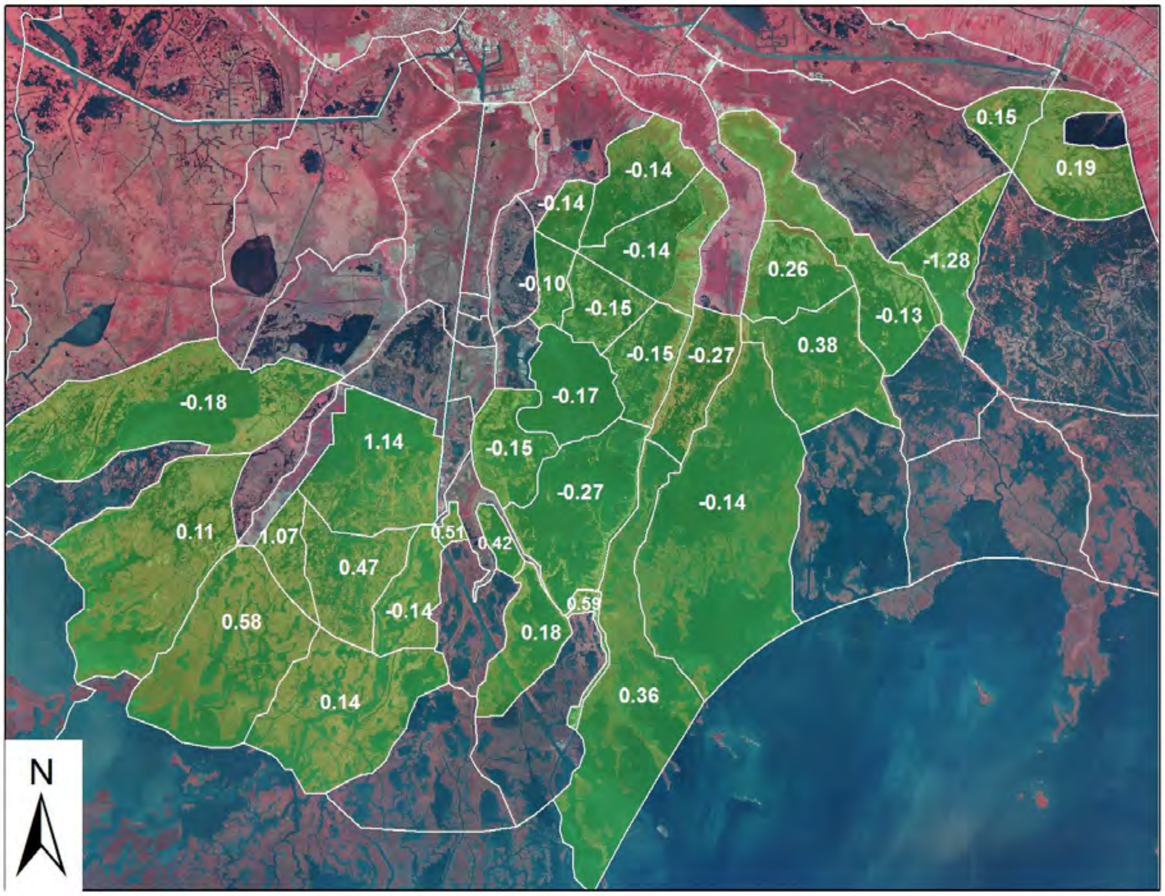
Table 4. Summary of wetland impacts in AAHUs* for the constructable features.

35-Year Levee Reaches - Direct Impacts					100-Year Levee Reaches - Direct Impacts				
Levee Reach	Habitat Type	Low SLR AAHUs	Med SLR AAHUs	High SLR AAHUs	Levee Reach	Habitat Type	Low SLR AAHUs	Med SLR AAHUs	High SLR AAHUs
F-1	FM/INT	-24.97	-23.80	-22.04	F-1	FM/INT	-28.04	-26.74	-24.79
F-1	BR	-175.63	-162.86	-130.44	F-1	BR	-217.77	-201.58	-165.26
	Total	-200.60	-186.66	-152.48		Total	-245.81	-228.32	-190.06
F-2	BR	-50.31	-48.09	-44.53	F-2	BR	-62.01	-59.14	-54.83
G-1	FM	-11.74	-11.74	-11.74	G-1	FM	-12.74	-12.74	-12.74
G-1	BR	-78.97	-72.37	-61.98	G-1	BR	-99.16	-90.26	-76.96
	Total	-90.71	-84.11	-73.71		Total	-111.90	-103.00	-89.70

* *floodgate impacts included in levee reach impacts*

A model run was conducted where the HNC Lock was closed year-round, but all other gates were open year-round (Plan 3). Relative to FWOP, salinity changes associated with Plan 3 were greater than those for Plan 1. However, because the Lock would be closed for only a fraction of the year, and closure would consist of discontinuous periods during the late summer and fall months, the salinity changes due to actual Lock closures would likely be a fraction of those predicted via the Plan 3 simulation. The differences between FWOP and Plan 3 salinities were examined to determine which differences were great enough to change the WVA's salinity

Figure 12. Plan 1 induced change in average annual salinities >= 0.10 parts per thousand.



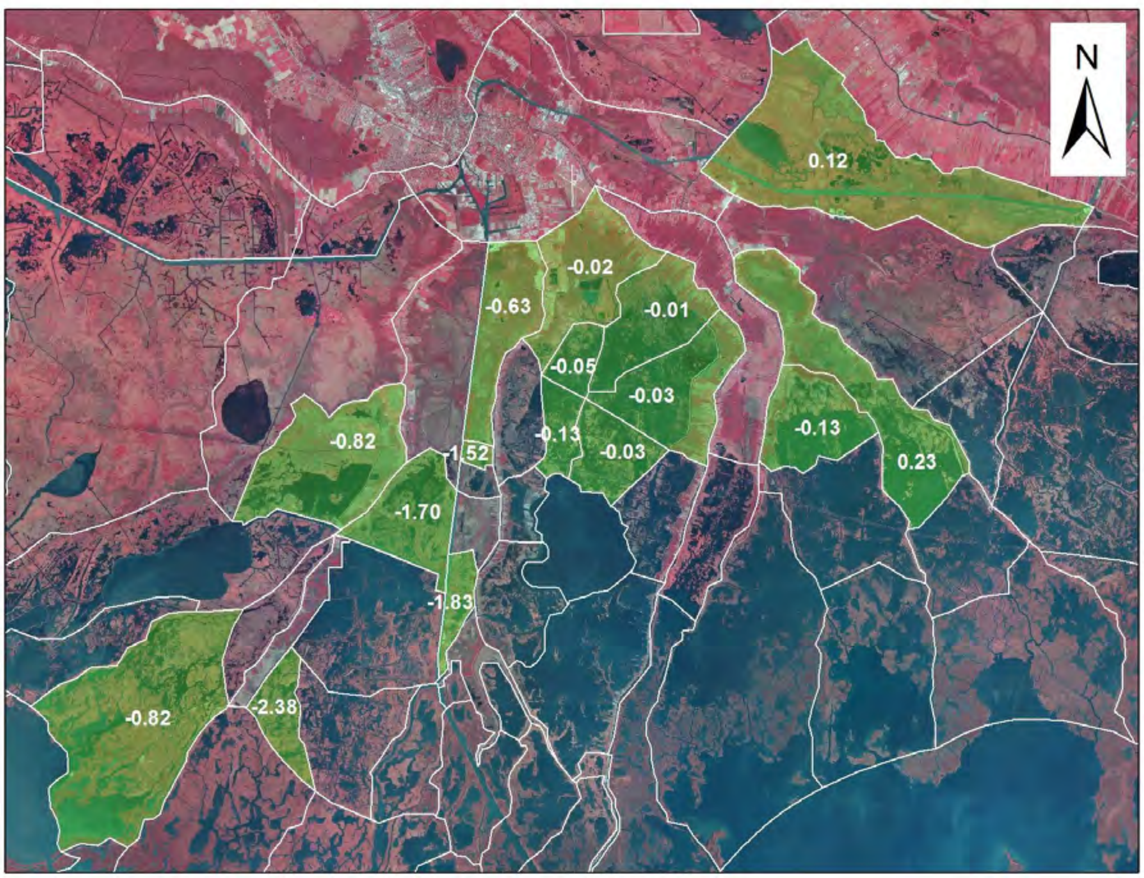
suitability index values. Because brackish and saline marshes have a wide optimal salinity range, there were no study area subunits in which the Plan 3 salinity changes caused a salinity shift beyond the optimal range. Because actual salinity changes would be less than those induced by Plan 3, it was determined that there would likely be no actual salinity change benefits or impacts measureable via the WVA brackish or saline marsh models. However, Plan 3 did change salinities for fresh and intermediate marshes to the extent that the WVA would capture salinity change benefits/impacts. To estimate effects of Lock closures, the high estimate of Lock closure duration (15.5% of the year) was used. Plan 3 salinities from those closure periods were placed into Plan1 salinities for those periods when Plan1 salinities were > 7.5 ppt for 24 hours or more. The results were deemed as the Modified Plan 1, and average annual growing season salinities were calculated as required by the WVA fresh/intermediate marsh model (Figure 13).

The most substantial salinity changes produced by the Modified Plan 1 are found adjacent to the HNC and north of the Lock. Those salinity reductions would produce WVA benefits. Salinity increases occurred south of the Lock, however, the predicted salinity increases remained within the optimal salinity range for those brackish and saline marshes. Given the uncertainties regarding duration of Lock closure, and the fact that model results were not available to make direct estimates of the anticipated short duration Lock closures, the HET decided there was too much uncertainty to assess benefits or impacts associated with project-induced salinity changes.

The HET's assessment of fisheries access impacts was also clouded with uncertainities regarding Lock closure duration. When the Lock is closed, the Bayou Grand Caillou Floodgate would provide fish access to areas north of the Lock. That floodgate would reduce existing cross-sections by approximately 18%. Lacking any model output on water exchange reductions, the HET assumed that this relatively small cross-section reduction would have a minimal impact, if any, on fisheries access. The HET felt that any fish access impacts associated with HNC Lock closures might be offset by salinity reduction benefits and opted to disregard the anticipated minor effects. Consequently, the HET did not use the WVA to quantify indirect impacts associated with constructable features.

Fish access impacts for the enclosed Lake Boudreaux Basin could not be determined given the lack of FWOP cross-sections for the proposed floodgates at Bush Canal, Placid Canal, and Bayou Petit Caillou, and/or predicted water exchange data. Given that the cross-section reductions are likely not substantial, and that historic water exchange has been drastically increased through

Figure 13. Modified Plan 1 induced average annual growing season salinity change for subunits where WVA salinity impacts/benefits are possible.

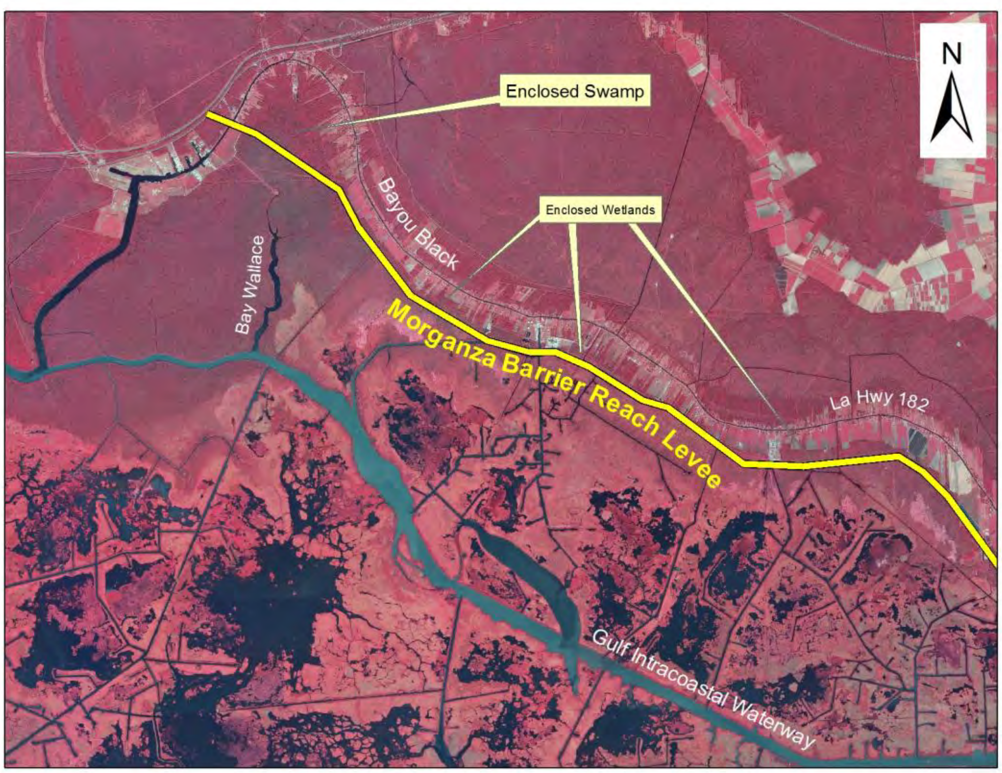


construction of man-made canals, the HET concluded that current levels of fish access would likely not be significantly reduced, if at all. A similar conclusion was reached for enclosed marshes east of Bayou Pointe au Chene given that much of that area currently has restricted fish access.

The HET assumed that project floodgates and other water control structures would be closed only to provide protection against tidal surges associated with tropical storms. This assumption excludes gate closures to curtail high tide conditions or to counter the long-term effects of subsidence and sea level rise. Should the project sponsors wish to expand gate operations to include such forms of protection, additional impact assessments would be needed to evaluate impacts to fish access and possibly other hydrology impacts and benefits.

Levees for Reach A and the Barrier Reach would enclose a fairly large acreage of fresh marsh and swamp located along the southern flank of Bayou Black. At the current programmatic level of planning, details are not available regarding measures to avoid ponding of excess water within those enclosed wetlands. Although floodgates are proposed to provide navigation and drainage, spoil banks along those canal banks may preclude drainage of water from the enclosed wetland areas and no details are available on spoil bank gapping or other measures to avoid drainage impairment impacts for those areas. The most significant such problem area is at the extreme western end of the Barrier Reach where the levee cuts across a large tract of swamp area north of Bay Wallace. Without measures to maintain drainage for this enclosed swamp, project-induced impaired drainage may increase the degradation rate of the enclosed cypress swamp (Figure 14).

Figure 14. Map depicting locations of wetland enclosed by the Barrier Reach levees.

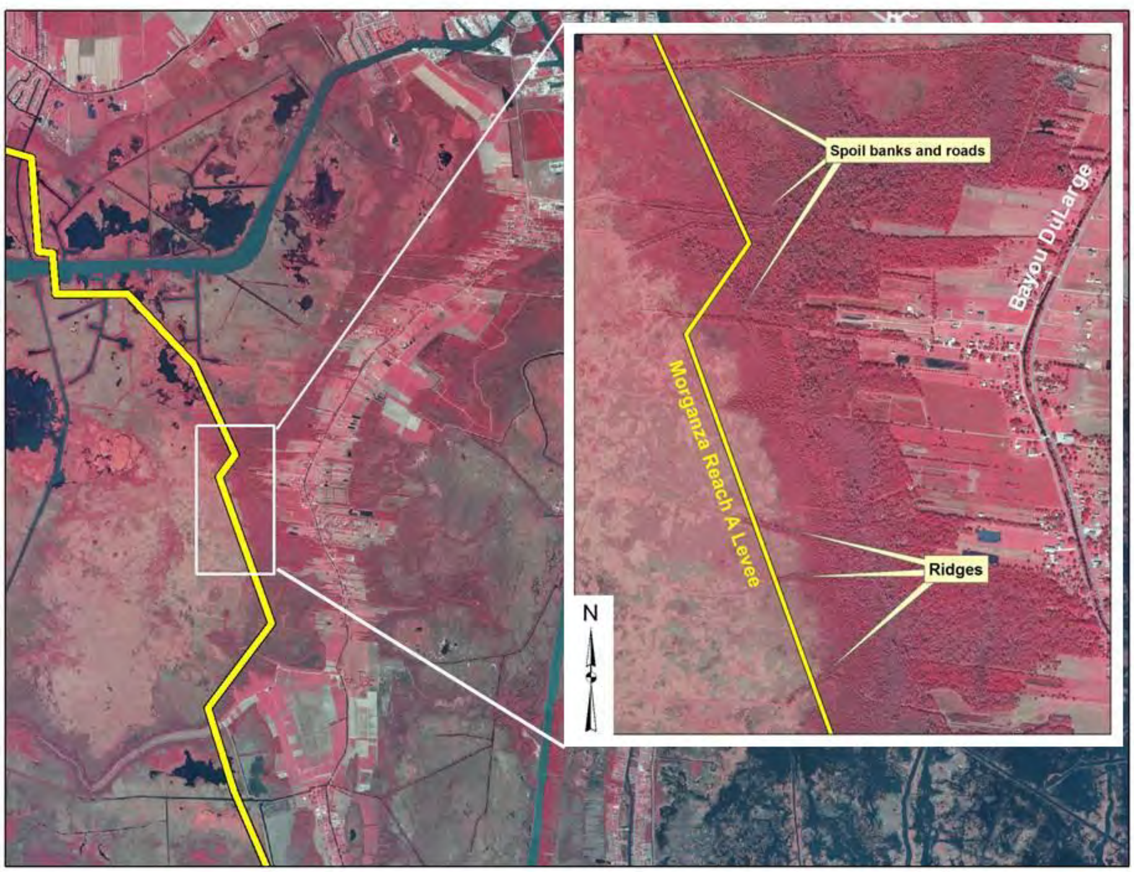


Between the south end of the Reach A levee and the Bayou DuLarge ridge, sections of enclosed wetlands would be isolated from one another by a series of ridges and spoil banks (Figure 15). Construction of a small internal drainage canal or other measures would be needed to provide drainage for each of these isolated drainage areas. Without effective drainage measures, ponding of excess water may lead to loss of enclosed marshes and forested habitats.

For proposed floodgates evaluated at the programmatic level, the Service is concerned that the western GIWW floodgate might result in increased water levels west of that structure. Chronic project-induced elevation of water levels in those Penchant area marshes may increase area marsh loss rates. Consequently, the evaluation of that floodgate should assess water surface elevation changes as well as effects on seasonal freshwater transport to the east. Design of that floodgate should avoid these impacts to the greatest degree possible.

Depending on its size, the proposed Grand Bayou Floodgate would potentially reduce the seasonal southward flow of fresh water to the rapidly deteriorating marshes south of proposed levee. The LCA Convey Atchafalaya River Water to Northern Terrebonne PEIS determined that substantial wetland restoration benefits to marshes south of the proposed levee might be obtained

Figure 15. Map depicting the location of possible drainage impaired wetlands within Reach A levees.



when the Grand Bayou Canal was significantly enlarged to increase seasonal southward freshwater inputs (U.S. Army Corps of Engineers and Louisiana Coastal Protection and Restoration Authority 2010). Those FWP freshwater inputs might be increased if the proposed GIWW Floodgate in Larose were constructed with as small a cross-section area as possible to reduce the loss of Atchafalaya River flows into the Barataria Basin. These coastal wetland restoration needs should be taken into account when design of these floodgates is begun.

Levee Reaches L and K would be located along the west bank of Cutoff Canal and Grand Bayou Canal. Those waterways currently serve as major conduits for saltwater intrusion into the upper Grand Bayou watershed. Dredging from those channels for material to construct the proposed levees would increase the size of those channels and the hydrologic impacts associated with those channels (saltwater intrusion and rapid loss of introduced fresh water). Designs for those levee reaches should avoid exacerbating the hydrologic problems caused by those existing channels.

Based on the Corps' assessment of storm surge impacts, the lower elevation levee alternative (35-year protection alternative) is occasionally overtopped and damages under that alternative are greater than those of the higher elevation levee alternative. Given that the 100-year protection alternative has a positive benefit/cost ratio, the Corps has chosen the 100-yr event protection alternative as the tentatively selected alternative.

FISH AND WILDLIFE CONSERVATION MEASURES

The President's Council on Environmental Quality defined the term "mitigation" in the National Environmental Policy Act regulations to include the following elements as the desirable sequence of steps in the mitigation planning process:

a) avoiding the impact altogether by not taking a certain action or parts of an action;

b) minimizing impacts by limiting the degree or magnitude of the action and its implementation;

c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and

e) compensation for the impact by replacing or providing substitute resources or environments.

The Service's mitigation policy (Federal Register, Volume 46, Number 15, pages 7656-7663, January 23, 1991) provides guidance to help ensure that the level of mitigation recommended by the Service is consistent with the value and scarcity of the fish and wildlife resources involved. In keeping with that policy, the Service usually recommends that losses of high-value habitats which are becoming scarce be avoided or minimized to the greatest extent possible. Unavoidable losses of such habitats should be fully compensated by replacement of the same kind of habitat value; this is called "in-kind" mitigation.

Coastal marshes are considered by the Service to be aquatic resources of national importance due to their increasing scarcity and high habitat value for fish and wildlife within Federal trusteeship (i.e., migratory waterfowl, wading birds, other migratory birds, threatened and endangered species, and interjurisdictional fisheries). Therefore, the Service recommends that unavoidable losses of those habitats be compensated in-kind

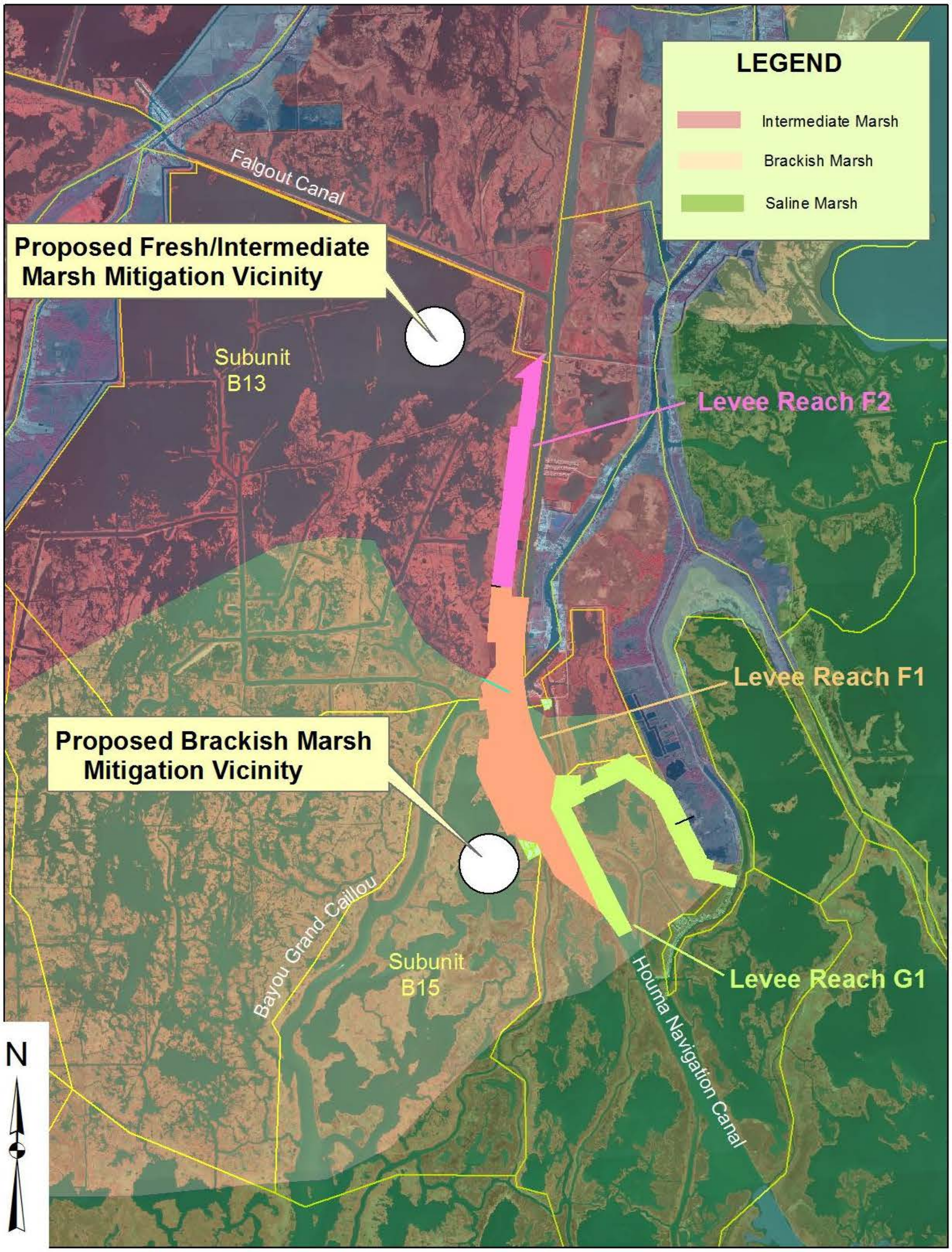
The New Orleans District Corps of Engineers has worked closely with the HET to develop plans for the constructable features. Through that process, efforts to avoid and minimize impacts to wetlands and fish and wildlife resources have been made. To mitigate unavoidable impacts to brackish and fresh/intermediate marshes, the HET has conducted WVAs on possible marsh creation projects in nearby brackish and intermediate marshes (Figure 16) under medium SLR scenario conditions. WVA variables for mitigation projects are provided in Appendix A, Table A-3. Based on those WVAs, mitigation for impacted fresh/intermediate marshes and brackish marshes, would be achieved at 0.29 AAHUs/marsh creation acre and 0.45 AAHUs/marsh creation acre, respectively. Using these HET-calculated mitigation ratios, the medium SLR scenario impacts for the 35-year levee alternative constructable features of 35.54 and 283.32 AAHUs for fresh/intermediate marsh and brackish marsh respectively, would be mitigated by constructing at least 123 acres of fresh/intermediate marsh and 626 acres of brackish marsh. Similarly, the medium SLR scenario impacts for the 100-year levee alternative constructable features of 39.48 and 350.98 AAHUs for fresh/intermediate marsh and brackish marsh, respectively, would be mitigated by constructing at least 137 acres of fresh/intermediate marsh and 776 acres of brackish marsh.

The mitigation analysis was conducted assuming that the created marsh platform would be planted with the appropriate marsh grass species. Consequently, such plantings would likely be needed to achieve the estimated mitigation benefits. The marsh creation projects should be monitored to ensure that the desired mitigation is achieved at a point 5 years after project implementation, and at 10 year intervals thereafter. Successful marsh creation will depend on achieving a settled disposal area elevation conducive to marsh vegetation establishment.

Because past experience shows that shortfalls in created marsh acreage often occur, the Service recommends that the target marsh acreage should be set above the required acreage, or that the contractor must guarantee that the required acreage will be established. The Service also recommends that the Corps monitor the acreage of created marsh, and other affected wetlands in the project area, throughout the project life to help assess project impacts and ensure that full compensatory mitigation is achieved. The resulting monitoring should be used to assess the need for additional mitigation, if monitoring reveals a mitigation shortfall.

Dredging of water bottoms for marsh creation material may result in the creation of deep holes. A lack of flushing in those areas may occur resulting in the development of anoxic conditions due to the accumulation of organic matter and pollutants. Anoxia would be aggravated by high temperature and salinity stratification, particularly during the summer months. To avoid such

Figure 16. Map depicting the location of mitigation sites.



problems, borrow areas should be designed to minimize the likelihood that anoxic conditions would develop.

Because of the large quantity of dredged material potentially needed to mitigate project impacts, careful consideration should be given to the borrow site design. If borrow sites are dredged to shallow depths to avoid creating anoxic sumps, then more surface area will need to be dredged to obtain the needed quantity of material. By dredging over a larger surface area, potential complications may include: 1) more benthos may be affected, which may reduce (at least temporarily) food availability for fishery organisms; 2) other sessile organisms, such as oysters, could be affected; and 3) by continually moving the cutterhead, the resuspended sediments will take longer to settle and could prolong the periods of high turbidity associated with dredging operations. The Service is also concerned that extensive borrow from linear waterways or canals may exacerbate saltwater intrusion and/or bank failure, resulting in accelerated marsh loss rates. Borrow sites should be located and designed to avoid those possible impacts.

A portion of Reach A levees would be located within the Mandalay National Wildlife Refuge. The Corps must obtain a right-of-way from the Service prior to conducting any work on that Refuge, in conformance with Section 29.21-1, Title 50, Right-of-Way Regulations. Issuance of a right-of-way will be contingent on a determination by the Service's Regional Director that the proposed work will be compatible with the purposes for which the Refuge was established. So that the Service may make that determination, the Corps should provide the Refuge Manager with a concise description of the project and project features to be located on the Refuge, including a construction schedule, construction methods, and equipment to be used. The Service will use that information to assess the extent of any short-term, long-term, direct, and/or indirect impacts. Additionally, public review and comments will be obtained prior to issuing a final determination.

Construction related wetland losses occurring on the Refuge would need to be mitigated on Refuge lands. If the West GIWW Floodgate is determined to cause elevated water levels and associated waterlogging impacts to refuge marshes, additional compensatory mitigation measures would be required to offset those losses and that mitigation should be located within Mandalay National Wildlife Refuge.

Regarding project features for which immediate construction authorization is not being sought, the Service recommends that the Corps continue to work with the Service and other interested natural resource agencies to avoid and minimize adverse impacts to area wetlands and fish and wildlife resources. That cooperation should begin early in the planning process to avoid potential conflicts and to increase planning efficiency.

SERVICE POSITION AND RECOMMENDATIONS

The Service has recommended via its 1994 Planning Aid Report for the Reconnaissance Phase of this study, and in letters dated May 3, 1996, October 30, 1997, February 17, 1998, July 29, 1998, and September 3, 1998, that project features be designed and located to avoid impacting critical freshwater inflow and to improve freshwater distribution within the study area. In the Service's view, such action is needed for the project to be consistent with the Louisiana Coastal Wetlands

Restoration Plan, as required by Section 303(d)(1) of the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA).

The Service is pleased that the Corps has conducted system-wide hydrologic modeling to assess project effects on freshwater inputs to wetlands within and adjacent to the proposed Morganza protection system. The results to date suggest that the Morganza system will not reduce those critically important freshwater inputs. However, the recently imposed deadline for completion of the feasibility study and revised PEIS has precluded the full use of that modeling effort to assess project effects. The evaluation of HNC Lock operations to improve the distribution of Atchafalaya River freshwater inputs was transferred to the LCA Convey Atchafalaya River Water to Northern Terrebonne Project feasibility study. Unfortunately, the schedule for that feasibility study, published in 2010, precluded satisfactory analysis of those benefits and post-authorization modeling of this LCA project does not at this time appear orientated to achieve that goal. Should Congress re-authorize the Morganza Project, project sponsors should seek to assess effects of those HNC Lock closures for saltwater intrusion abatement as well as improved freshwater distribution.

Because many details regarding the design, operation and impacts of Morganza features are not yet available, we cannot complete our evaluation of project effects on fish and wildlife resources, nor can we entirely fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act. Therefore, extensive additional Service involvement during the preconstruction engineering and design phase of this project, along with more-definitive project information, will be required so that we can fulfill our responsibilities under that Act.

Available information indicates that substantial direct wetland losses will result from construction of project features. Consequently, avoidance and minimization of direct wetland impacts should be pursued to the greatest extent practicable. The Service provides the following recommendations to avoid and/or minimize project impacts on fish and wildlife resources, and for mitigating unavoidable impacts to those resources.

1. The Post Authorization Report, in keeping with the project's Congressional Authorization, should clearly reiterate that features of the Tentatively Selected Plan will be designed to maintain existing freshwater inflows from the Atchafalaya River via the Gulf Intracoastal Waterway. Those designs shall accommodate newly identified restoration needs determined via future restoration planning, to the extent possible. The Service also recommends that the Corps provide the Service with the opportunity to review and comment on model assumptions and input data prior to initiating the modeling analyses necessary to complete those tasks. Tasks should include the following:

    a. Future design of the Grand Bayou Canal Floodgate should accommodate southward freshwater flows determined via the LCA Convey Atchafalaya River Water to Northern Terrebonne Project's ongoing assessment of Grand Bayou restoration alternatives.
    b. Construction of Reach L and K levees should avoid use of material dredged from Grand Bayou Canal and from the Cutoff Canal so that saltwater intrusion

via those channels is not increased.

c. The east GIWW floodgate should have the smallest possible cross-section to reduce the loss of Atchafalaya River freshwater to the Barataria Basin and to retain that freshwater within the Terrebonne Basin.
d. The design of the west GIWW floodgate should avoid stage increases west of that structure and should be capable of passing Atchafalaya River freshwater flows, especially during periods of high Atchafalaya River stages, without any loss of flow .
e. The two environmental water control structures at Falgout Canal should be designed and operated to only discharge freshwater southward and not to allow northward flow of saltwater into Falgout Canal.

2. The Corps should coordinate closely with the Service and other fish and wildlife conservation agencies throughout the engineering and design of project features including levees, floodgates, and environmental water control structures to ensure that those features are designed, constructed and operated consistent with wetland restoration and associated fish and wildlife resource needs.

3. Operational plans for floodgates and water control structures, excluding the Falgout Canal structure, should be developed to maximize the cross-sectional area open for as long as possible. Operations to maximize freshwater retention or redirect freshwater flows could be considered if hydraulic modeling demonstrates that is possible and such actions are recommended by the natural resource agencies. Development of water control manuals or plans should be done in coordination with the Service and other natural resource agencies.

4. The location of the Barrier Reach and Reach A levees should be modified to reduce direct wetland impacts and enclosure of wetlands. Features such as spoil bank gapping or other measures should also be added to avoid impacts to enclosed wetlands due to impaired drainage. The Corps should coordinate with the Service and other natural resource agencies to develop the best approach for avoiding drainage impacts.

5. Estimates of all direct and indirect project-related wetland impacts, including those associated with changes in freshwater inflows and distribution, should be refined during the engineering and design phase, including impacts associated with the proposed HNC Lock closures to preclude saltwater intrusion.

6. To the greatest degree practical, the hurricane protection levees and borrow pits should be located to avoid and minimize direct and indirect impacts to emergent wetlands. Efforts should be made to further reduce those direct impacts by hauling in fill material, using sheetpile for the levee crest, deep soil mixing, or other alternatives.

7. When organic soils must be removed from the construction site, that material should be used to create or restore emergent wetlands to the greatest extent

practicable. If that is not practicable, then use of that material to improve borrow pit habitat quality (e.g., construct bank slopes, reduce depths, etc.) should be examined.

8. Forest clearing associated with project features should be conducted during the fall or winter to minimize impacts to nesting migratory birds, when practicable.

9. Avoid adverse impacts to bald eagle nesting locations and wading bird colonies through careful design of project features and timing of construction. Surveys prior to construction such be undertaken to ensure no nesting birds are within 1,000 feet of any proposed work. If nesting birds are found within 1,000 feet of any proposed work sites, the Service and the Louisiana Department of Wildlife and Fisheries should be contacted for procedures to avoid impacts.

10. Full, in-kind compensation (quantified as AAHUs) should be provided for unavoidable net adverse impacts on forested wetlands, marsh, and associated submerged aquatic vegetation, including any additional losses identified during post-authorization engineering and design studies. To help ensure that the proposed mitigation features meet their goals, the Service provides the following recommendations.

    a. Mitigation measures should be constructed concurrently with the features that they are mitigating.
    b. The Service and other fish and wildlife conservation agencies should be consulted in the development of plans and specifications for all mitigation features and any monitoring and/or adaptive management plans.
    c. Unavoidable impacts to wetlands within Mandalay National Wildlife Refuge should be mitigated on the refuge.
    d. The acreage of marsh created to mitigate project impacts should meet or exceed the marsh acreage projected by the Habitat Evaluation Team for target year 5.
    e. To avoid shortfalls in marsh creation acreage, the contractor should be required to guarantee the creation of at least the target acreage of marsh platform, or excess acres should be created.
    f. The acreage of marsh created for mitigation purposes, and adjacent affected wetlands, should be monitored over the project life to evaluate project impacts, the effectiveness of compensatory mitigation measures, and the need for additional mitigation should those measures prove insufficient.
    g. Dredged material borrow pits, including those utilized to create marsh for mitigation purposes, should be carefully designed and located to minimize anoxia problems and excessive disturbance to area water bottoms, and to avoid increased saltwater intrusion.
    h. If applicable, a General Plan should be developed by the Corps, the Service, and the managing natural resource agency in accordance with Section 3(b) of the FWCA for mitigation lands.

11. Extensive additional information is needed by the Service to complete the required evaluation of project effects and fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act. Much of that information will not be available until engineering and design of the project features has progressed. To help ensure that sufficient information is provided, the Service recommends that the Corps perform the following tasks during the engineering and design phase.

    a. Provide additional information on anticipated construction techniques and their associated wetland impacts, such as additional dredging to install floodgates and water control structures, dredging temporary by-pass channels, and the method for disposing organic surface soils that are unsuitable for levee construction.
    b. Provide final locations and designs for borrow sites used in levee construction.

12. Sufficient funding should be provided for full Service participation in the post-authorization engineering and design studies, and to facilitate fulfillment of its responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act.

14. The Corps should obtain a right-of-way from the Service prior to conducting any work on Mandalay National Wildlife Refuge, in conformance with Section 29.21-1, Title 50, Right-of-Way Regulations. Issuance of a right-of-way will be contingent on a determination by the Service's Regional Director that the proposed work will be compatible with the purposes for which the Refuge was established.

15. All construction or maintenance activities (e.g., surveys, land clearing, etc.) on Mandalay National Wildlife Refuge (NWR) will require the Corps of Engineers (Corps) to obtain a Special Use Permit from the Refuge Manager; furthermore, all activities on that NWR must be coordinated with the Refuge Manager . Therefore, we recommend that the Corps request issuance of a Special Use Permit well in advance of conducting any work on the refuge. Please contact the Refuge Manager (985/853-1078) for further information on compatibility of flood control features, and for assistance in obtaining a Special Use Permit. Close coordination by both the Corps and its contractor must be maintained with the Refuge Manager to ensure that construction and maintenance activities are carried out in accordance with provisions of any Special Use Permit issued by the NWR.

16. If mitigation lands are purchased for inclusion within a NWR those lands must meet certain requirements; a summary of some of those requirements is provided in Appendix C. Other land-managing natural resource agencies may have similar requirements that must be met prior to accepting mitigation lands; therefore, if they are proposed as a manager of a mitigation site, they should be contacted early in the planning phase regarding such requirements.

17. The Corps should contact the Louisiana Department of Wildlife and Fisheries prior

to conducting any work on Point au Chene Wildlife Management Area (985-594-5494).

Given that design and evaluation of most Morganza Project features has been at a programmatic level, the Service cannot fulfill its Coordination Act responsibilities at this time. Hence, we will require additional funding during the post-authorization engineering and design phase of this project to fulfill our responsibilities under the Fish and Wildlife Coordination Act. Estimates of those funding needs should be coordinated in advance with the Service, and should be based on the nature and complexity of issues associated with the project design and implementation.

Provided that the above recommendations and associated funding needs are included in the feasibility report and related authorizing documents, the Service does not oppose further planning and implementation of the TSP.

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APPENDIX A

WVA VARIABLES USED TO ASSESS IMPACTS AND MITIGATION MEASURES

Table A-1. FWOP WVA variables for assessing direct impacts of constructable features of the 35-year protection alternative.

Levee Reach	Loss Subunit	Habitat Type	35-Year Levee Alternative Low SLR					35-Year Levee Alternative Medium SLR					35-Year Levee Alternative High SLR				
			TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-2	B13	INT	V1	81	79	0	0	V1	81	79	0	0	V1	81	79	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	80	80			V3-1	80	80			V3-1	80	80		
			V3-2	10	10			V3-2	10	10			V3-2	10	10		
			V3-3	10	10			V3-3	10	10			V3-3	10	10		
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	35	35	3	0	V4	35	35	3	0	V4	35	35	2	0
			V5	0	0	0	0	V5	0	0	0	0	V5	0	0	0	0
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6					V6					V6				
			V6	1.00	1.00	1.00	1.00	V6	1.00	1.00	1.00	1.00	V6	1.00	1.00	1.00	1.00
			TOT Ac	151	151	151	151	TOT Ac	151	151	151	151	TOT Ac	151	151	151	151
			% MF	0	0	0	0	% MF	0	0	0	0	% MF	0	0	0	0
			% INT	100	100	100	100	% INT	100	100	100	100	% INT	100	100	100	100

Levee Reach	Loss Subunit	Habitat Type	TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-1	B13	INT	V1	88	86	0	0	V1	88	86	0	0	V1	88	86	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	20	20	1	0	V4	20	20	1	0	V4	20	20	1	0
			V5	0	0	5	5	V5	0	0	5	5	V5	0	0	5	5
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6	0	0	1	1	V6	0	0	1	1	V6	0	0	1	1
			V6	1	1	1	1	V6	1	1	1	1	V6	1	1	1	1
			TOT Ac	76	76	76	76	TOT Ac	76	76	76	76	TOT Ac	76	76	76	76
			% MF	7	7	7	7	% MF	7	7	7	7	% MF	7	7	7	7
			% INT	93	93	93	93	% INT	93	93	93	93	% INT	93	93	93	93

Levee Reach	Loss Subunit	Habitat Type	TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-1	B13	BR	V1	82	80	0	0	V1	82	80	0	0	V1	82	80	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	60	60	1	0	V4	60	60	1	0	V4	60	60	1	0
			V5					V5					V5				
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6					V6					V6				
			V6	1	1	1	1	V6	1	1	1	1	V6	1	1	1	1
			TOT Ac	11	11	11	11	TOT Ac	11	11	11	11	TOT Ac	11	11	11	11

Table A-1. FWOP WVA variables for assessing direct impacts of constructable features of the 35-year protection alternative - continued.

Levee Reach	Loss Subunit	Habitat Type	35-Year Levee Alternative Low SLR					35-Year Levee Alternative Medium SLR					35-Year Levee Alternative High SLR				
			TY	0	1		70	TY	0	1		70	TY	0	1		70
F-1	**B15**	**BR**	V1	77	77		53	V1	77	77		41	V1	77	77		1
			V2	0	0		0	V2	0	0		0	V2	0	0		0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2				30	V3-2				20	V3-2				
			V3-3	30	30		40	V3-3	30	30		40	V3-3	30	30		
			V3-4				30	V3-4				40	V3-4				
			V3-5					V3-5					V3-5				100
			V4	15	15		6	V4	15	15		5	V4	15	15		0
			V5					V5					V5				
			V5	5	5		5	V5	5	5		5	V5	5	5		5
			V6					V6					V6				
			V6	1	1		1	V6	1	1		1	V6	1	1		1
			TOT Ac	244	244		244	TOT Ac	244	244		244	TOT Ac	244	244		244

Levee Reach	Loss Subunit	Habitat Type															
			TY	0	1		70	TY	0	1		70	TY	0	1	60	70
F-1	**C21**	**BR**	V1	70	70		32	V1	70	70		20	V1	70	70	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0		0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3				20	V3-3				15	V3-3				
			V3-4				80	V3-4				85	V3-4				
			V3-5					V3-5					V3-5			100	100
			V4	25	25		5	V4	25	25		3	V4	25	25	0	0
			V5					V5					V5				
			V5	8	8		8	V5	8	8		8	V5	8	8	8	8
			V6					V6					V6				
			V6	1	1		1	V6	1	1		1	V6	1	1	1	1
			TOT Ac	36	36		36	TOT Ac	36	36		36	TOT Ac	36	36	36	36

Levee Reach	Loss Subunit	Habitat Type															
			TY	0	1		70	TY	0	1		70	TY	0	1	60	70
F-1 Ea.	**C20**	**BR**	V1	93	93		43	V1	93	93		27	V1	93	92	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0	0	0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2					V3-2					V3-2				
			V3-3	30	30		90	V3-3	30	30			V3-3	30	30		
			V3-4				10	V3-4				30	V3-4				
			V3-5					V3-5				70	V3-5			100	100
			V4	5	5		2	V4	5	5		0	V4	5	5	0	0
			V5					V5					V5				
			V5	6	6		6	V5	6	6		6	V5	6	6	6	6
			V6					V6					V6				
			V6	1	1		1	V6	1	1		1	V6	1	1	1	1
			TOT Ac	4	4		4	TOT Ac	4	4		4	TOT Ac	4	4	4	4

Table A-1. FWOP WVA variables for assessing direct impacts of constructable features of the 35-year protection alternative – continued.

			35-Year Levee Alternative					35-Year Levee Alternative					35-Year Levee Alternative				
Levee	Loss	Habitat	Low SLR					Medium SLR					High SLR				
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	59	70
G-1	C20	BR	V1	80	80		36	V1	80	80		22	V1	80	79	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0	0	0
			V3-1					V3-1					V3-1				
			V3-2	100	100			V3-2	100	100			V3-2	100	100		
			V3-3				50	V3-3				30	V3-3				
			V3-4				50	V3-4				70	V3-4				
			V3-5					V3-5					V3-5			100	100
			V4	5	5		1	V4	5	5		1	V4	5	5	0	0
			V5					V5					V5				
			V5	6	6		6	V5	6	6		6	V5	6	6	6	6
			V6					V6					V6				
			V6	1	1		1	V6	1	1		1	V6	1	1	1	1
			TOT Ac	2	2		2	TOT Ac	2	2		2	TOT Ac	2	2	2	2
Levee	Loss	Habitat															
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	59	70
G1	C21	BR	V1	77	76		34	V1	77	76		20	V1	77	76	0	0
			V2	5	5		0	V2	5	5		0	V2	5	5	0	0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2					V3-2					V3-2				
			V3-3	30	30			V3-3	30	30			V3-3	30	30		
			V3-4				40	V3-4				30	V3-4				
			V3-5				60	V3-5				70	V3-5			100	100
			V4	7	7		2	V4	7	7		1	V4	7	7	0	0
			V5					V5					V5				
			V5	8	8		8	V5	8	8		8	V5	8	8	8	8
			V6					V6					V6				
			V6	1	1		1	V6	1	1		1	V6	1	1	1	1
			TOT Ac	143	143		143	TOT Ac	143	143		143	TOT Ac	143	143	143	143
Levee	Loss	Habitat															
Reach	Subunit	Type	TY	TY	1		70	TY	0	1		70	TY	0	1	70	
G1	C19	FM	V1	73	73		73	V1	73	73		73	V1	73	73	73	
	Force		V2	10	10		10	V2	10	10		10	V2	10	10	10	
	Drained		V3-1	65	65		65	V3-1	65	65		65	V3-1	65	65	65	
			V3-2	35	35		35	V3-2	35	35		35	V3-2	35	35	35	
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5					V3-5					V3-5				
			V4	65	65		65	V4	65	65		65	V4	65	65	65	
			V5					V5					V5				
			V5	0	0		0	V5	0	0		0	V5	0	0	0	
			V6					V6					V6				
			V6	0	0		0	V6	0	0		0	V6	0	0	0	
			TOT Ac	19	19		19	TOT Ac	19	19		19	TOT Ac	19	19	19	
			% MF	100	100		100	% MF	100	100		100	% MF	100	100	100	
			% INT	0	0		0	% INT	0	0		0	% INT	0	0	0	

Table A-2. FWOP WVA variables for assessing direct impacts of constructable features of the100-year protection alternative.

Levee Reach	Loss Subunit	Habitat Type	100-Year Levee Alternative Low SLR					100-Year Levee Alternative Medium SLR					100-Year Levee Alternative High SLR				
			TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-2	B13	INT	V1	79	78	0	0	V1	79	78	0	0	V1	79	78	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	85	85			V3-1	85	85			V3-1	85	85		
			V3-2	7	7			V3-2	7	7			V3-2	7	7		
			V3-3	8	8			V3-3	8	8			V3-3	8	8		
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	25	25	1	0	V4	25	25	1	0	V4	25	25	1	0
			V5	0	0	5	5	V5	0	0	5	5	V5	0	0	5	5
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6	0.0	0.0	0.0	0.0	V6	0.0	0.0	0.0	0.0	V6	0.0	0.0	0.0	0.0
			V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	188	188	188	188	TOT Ac	188	188	188	188	TOT Ac	188	188	188	188
			% FM	0	0	0	0	% FM	0	0	0	0	% FM	0	0	0	0
			% INT	100	100	100	100	% INT	100	100	100	100	% INT	100	100	100	100

Levee Reach	Loss Subunit	Habitat Type	TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-1	B13	INT	V1	86	85	0	0	V1	86	85	0	0	V1	86	85	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	20	20	1	0	V4	20	20	1	0	V4	20	20	1	0
			V5	0	0	5	5	V5	0	0	5	5	V5	0	0	5	5
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6	0	0	1	1	V6	0	0	1	1	V6	0	0	1	1
			V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	85	85	85	85	TOT Ac	85	85	85	85	TOT Ac	85	85	85	85
			% FM	4	4	4	4	% FM	4	4	4	4	% FM	4	4	4	4
			% INT	96	96	96	96	% INT	96	96	96	96	% INT	96	96	96	96

Levee Reach	Loss Subunit	Habitat Type	TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-1	B13	BR	V1	81	80	0	0	V1	81	79	0	0	V1	81	79	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	60	60	1	0	V4	60	60	1	0	V4	60	60	1	0
			V5					V5					V5				
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6					V6					V6				
			V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	12	12	12	12	TOT Ac	12	12	12	12	TOT Ac	12	12	12	12

Table A-2. FWOP WVA variables for assessing direct impacts of constructable features of the 100-year protection - continued.

			100-Year Levee Alternative					**100-Year Levee Alternative**					**100-Year Levee Alternative**				
Levee	**Loss**	**Habitat**	**Low SLR**					**Medium SLR**					**High SLR**				
Reach	**Subunit**	**Type**	TY	0	1		70	TY	0	1		70	TY	0	1		70
F-1	**B15**	**BR**	V1	76	75		52	V1	75	75		40	V1	75	75		1
			V2	0	0		0	V2	0	0		0	V2	0	0		0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2				30	V3-2				20	V3-2				
			V3-3	30	30		40	V3-3	30	30		40	V3-3	30	30		
			V3-4				30	V3-4				40	V3-4				
			V3-5					V3-5					V3-5				100
			V4	15	15		6	V4	15	15		5	V4	15	15		0
			V5					V5					V5				
			V5	5	5		5	V5	5	5		5	V5	5	5		5
			V6					V6					V6				
			V6	1.0	1.0		1.0	V6	1.0	1.0		1.0	V6	1.0	1.0		1.0
			TOT Ac	258	258		258	TOT Ac	258	258		258	TOT Ac	258	258		258
Levee	**Loss**	**Habitat**															
Reach	**Subunit**	**Type**	TY	0	1		70	TY	0	1		70	TY	0	1	60	70
F-1	**C21**	**BR**	V1	86	85		38	V1	86	85		24	V1	86	85	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3				20	V3-3				15	V3-3				
			V3-4				80	V3-4				85	V3-4				
			V3-5					V3-5					V3-5			100	100
			V4	25	25		5	V4	25	25		3	V4	25	25	0	0
			V5					V5					V5				
			V5	8	8		8	V5	8	8		8	V5	8	8	8	8
			V6					V6					V6				
			V6	1.0	1.0		1.0	V6	1.0	1.0		1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	92	92		92	TOT Ac	92	92		92	TOT Ac	92	92	92	92
Levee	**Loss**	**Habitat**															
Reach	**Subunit**	**Type**	TY	0	1		70	TY	0	1		70	TY	0	1	60	70
F-1 Ea.	**C20**	**BR**	V1	93	93		43	V1	93	93		27	V1	93	92	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3				90	V3-3					V3-3				
			V3-4				10	V3-4				30	V3-4				
			V3-5					V3-5				70	V3-5			100	100
			V4	5	5		2	V4	5	5		0	V4	5	5	0	0
			V5					V5					V5				
			V5	6	6		6	V5	6	6		6	V5	6	6	6	6
			V6					V6					V6				
			V6	1.0	1.0		1.0	V6	1.0	1.0		1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	4	4		4	TOT Ac	4	4		4	TOT Ac	4	4	4	4

Table A-2. FWOP WVA variables for assessing direct impacts of constructable features of the 100-year protection - continued.

			100-Year Levee Alternative					100-Year Levee Alternative					100-Year Levee Alternative				
Levee	Loss	Habitat	Low SLR					Medium SLR					High SLR				
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	59	70
G-1	C20	BR	V1	69	69		31	V1	69	69		19	V1	69	69	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0	0	0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2					V3-2					V3-2				
			V3-3	30	30		50	V3-3	30	30		30	V3-3	30	30		
			V3-4				50	V3-4				70	V3-4				
			V3-5					V3-5					V3-5			100	100
			V4	10	10		2	V4	10	10		1	V4	10	10	0	0
			V5					V5					V5				
			V5	6	6		6	V5	6	6		6	V5	6	6	6	6
			V6					V6					V6				
			V6	1.0	1.0		1.0	V6	1.0	1.0		1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	4	4		4	TOT Ac	4	4		4	TOT Ac	4	4	4	4
Levee	Loss	Habitat															
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	59	70
G1	C21	BR	V1	78	78		35	V1	78	77		21	V1	78	77	0	0
			V2	5	5		0	V2	5	5		0	V2	5	5	0	0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2					V3-2					V3-2				
			V3-3	30	30			V3-3	30	30			V3-3	30	30		
			V3-4				40	V3-4				30	V3-4				
			V3-5				60	V3-5				70	V3-5			100	100
			V4	7	7		2	V4	7	7		1	V4	7	7	0	0
			V5					V5					V5				
			V5	8	8		8	V5	8	8		8	V5	8	8	8	8
			V6					V6					V6				
			V6	1.0	1.0		1.0	V6	1.0	1.0		1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	175	175		175	TOT Ac	175	175		175	TOT Ac	175	175	175	175
Levee	Loss	Habitat															
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	70	
G1	C19	FM	V1	79	79		79	V1	79	79		79	V1	79	79	79	
	Force		V2	10	10		10	V2	10	10		10	V2	10	10	10	
	Drained		V3-1	65	65		65	V3-1	65	65		65	V3-1	65	65	65	
			V3-2	35	35		35	V3-2	35	35		35	V3-2	35	35	35	
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5					V3-5					V3-5				
			V4	65	65		65	V4	65	65		65	V4	65	65	65	
			V5					V5					V5				
			V5	0	0		0	V5	0	0		0	V5	0	0	0	
			V6					V6					V6				
			V6	0.0	0.0		0.0	V6	0.0	0.0		0.0	V6	0.0	0.0	0.0	
			TOT Ac	33	33		33	TOT Ac	33	33		33	TOT Ac	33	33	33	
			% FM	100	100		100	% FM	100	100		100	% FM	100	100	100	
			% INT	0	0		0	% INT	0	0		0	% INT	0	0	0	

Table A–3. WVA variables used to determine benefits of marsh creation mitigation projects.

			Medium SLR			Medium SLR					
Loss Subunit	**Habitat Type**		FWOP TY0	FWOP TY1	FWOP TY70	FWP TY1	FWP TY3	FWP TY5	FWP TY6	FWP TY32	FWP TY70
B13	**INT**	V1	0	0	0	10	25	97	96	77	19
		V2	0	0	0	0	0	0	0	0	0
		V3-1						50	100	77	
		V3-2								23	
		V3-3					100	50			
		V3-4									15
		V3-5	100	100	100	100					85
		V4	20	20	0	100	100	100	100	100	5
		V5	0	0	0	0	0	0	0	0	0
		V5	5	5	5	4	4	4	4	4	4
		V6									
		V6	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00
		TOT Ac	100	100	100	100	100	100	100	100	100
		% FM	0	0	0	0	0	0	0	0	0
		% INT	100	100	100	100	100	100	100	100	100
Loss Subunit	**Habitat Type**		FWOP TY0	FWOP TY1	FWOP TY70	FWP TY1	FWP TY3	FWP TY5	FWP TY6	FWP TY32	FWP TY70
B15	**BR**	V1	0	0	0	10	25	99	99	90	64
		V2	0	0	0	0	0	0	0	0	0
		V3-1	70	70				50	100	90	
		V3-2			20					10	25
		V3-3	30	30	40		100	50			75
		V3-4			40						
		V3-5				100					
		V4	60	60	0	100	100	100	100	100	70
		V5									
		V5	5	5	5	4	4	4	4	4	4
		V6									
		V6	1	1	1	0.00	0.00	1	1	1	1
		TOT Ac	500	500	500	500	500	500	500	500	500

APPENDIX B

CONSTRUCTION IMPACTS BY LEVEE REACH AND HABITAT TYPE

Table B-1. Construction impacts of the 35-year alternative under the low SLR scenario.

	Fresh				INT		BR		SAL		Force Drained		Total	Total
35-Yr	Tidal Habitats				Tidal Habitats		Tidal Habitats		Tidal Habitats		(non-tidal)		Tidal	Tidal
Levee	Hwds	Swamp	Marsh	Water*	Marsh	Water*	Marsh	Water*	Marsh	Water*	Marsh	Water*	Water*	Marsh
Reach	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	acres	acres
Barrier	170	475	157	6	0	0	0	0	0	0	0	0	6	157
A	65	51	306	39	0	0	0	0	0	0	0	0	39	306
B	0	0	103	15	27	112	0	0	0	0	0	0	127	130
E-1	0	0	0	0	56	136	0	0	0	0	0	0	136	56
E-2	0	0	0	0	9	154	0	0	0	0	0	0	154	9
F-1	0	0	0	0	75	16	217	68	0	0	0	0	83	291
F-2	0	0	0	0	120	32	0	0	0	0	0	0	32	120
G-1	0	0	0	0	0	0	111	35	0	0	14	5	40	111
G-2	0	0	0	0	0	0	0	0	29	63	0	0	63	29
G-3	0	0	0	0	0	0	0	0	33	16	0	0	16	33
H-1	0	0	0	0	0	0	0	0	83	53	0	0	53	83
H-2	0	0	0	0	0	0	0	0	138	72	0	0	72	138
H-3	0	0	0	0	0	0	0	0	74	193	0	0	193	74
I-1	0	0	0	0	0	0	74	73	0	0	0	0	74	75
I-2	0	0	0	0	0	0	0	0	66	95	0	0	95	66
I-3	0	0	0	0	0	0	0	0	69	110	0	0	110	69
J-1	0	0	0	0	40	151	0	0	2	10	0	0	162	42
J-2	0	0	0	0	0	0	26	177	25	157	17	0	334	50
J-3	0	0	0	0	0	0	0	0	18	90	0	0	90	18
K	0	0	0	0	0	0	89	413	0	0	0	0	413	89
L	0	0	0	0	71	35	71	102	0	0	0	0	137	142
TOTAL	235	526	566	59	397	636	587	868	537	860	31	5	2,428	2,088
			* Natural water bodies, excluding large navigable bayous and actively used man-made canals											

Table B-2. Construction impacts of the 35-year alternative under the medium SLR scenario.

	Fresh				INT		BR		SAL		Force Drained		Total	Total
35-Yr	Tidal Habitats				Tidal Habitats		Tidal Habitats		Tidal Habitats		(non-tidal)		Tidal	Tidal
Levee	Hwds	Swamp	Marsh	Water*	Marsh	Water*	Marsh	Water*	Marsh	Water*	Marsh	Water*	Water*	Marsh
Reach	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	acres	acres
Barrier	170	475	157	6	0	0	0	0	0	0	0	0	6	157
A	65	51	305	39	0	0	0	0	0	0	0	0	39	305
B	0	0	103	15	27	112	0	0	0	0	0	0	127	130
E-1	0	0	0	0	56	136	0	0	0	0	0	0	136	56
E-2	0	0	0	0	9	154	0	0	0	0	0	0	154	9
F-1	0	0	0	0	75	16	217	68	0	0	0	0	84	291
F-2	0	0	0	0	120	32	0	0	0	0	0	0	32	120
G-1	0	0	0	0	0	0	111	35	0	0	14	5	40	111
G-2	0	0	0	0	0	0	0	0	29	63	0	0	63	29
G-3	0	0	0	0	0	0	0	0	33	16	0	0	16	33
H-1	0	0	0	0	0	0	0	0	83	53	0	0	53	83
H-2	0	0	0	0	0	0	0	0	138	72	0	0	72	138
H-3	0	0	0	0	0	0	0	0	74	193	0	0	193	74
I-1	0	0	0	0	0	0	74	74	0	0	0	0	74	75
I-2	0	0	0	0	0	0	0	0	66	95	0	0	95	66
I-3	0	0	0	0	0	0	0	0	69	110	0	0	110	69
J-1	0	0	0	0	40	151	0	0	2	10	0	0	162	42
J-2	0	0	0	0	0	0	26	177	24	157	17	0	334	50
J-3	0	0	0	0	0	0	0	0	18	90	0	0	90	18
K	0	0	0	0	0	0	89	413	0	0	0	0	413	89
L	0	0	0	0	71	35	71	102	0	0	0	0	137	142
TOTAL	235	526	565	60	397	636	587	868	536	860	31	5	2,430	2,085
			* Natural water bodies, excluding large navigable bayous and actively used man-made canals											

Table B-3. Construction impacts of the 35-year alternative under the high SLR scenario.

	Fresh				INT		BR		SAL		Force Drained		Total	Total
35-Yr	Tidal Habitats				Tidal Habitats		Tidal Habitats		Tidal Habitats		(non-tidal)		Tidal	Tidal
Levee	Hwds	Swamp	Marsh	Water*	Marsh	Water*	Marsh	Water*	Marsh	Water*	Marsh	Water*	Water*	Marsh
Reach	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	acres	acres
Barrier	170	475	156	8	0	0	0	0	0	0	0	0	8	156
A	65	51	303	41	0	0	0	0	0	0	0	0	41	303
B	0	0	103	15	27	113	0	0	0	0	0	0	127	130
E-1	0	0	0	0	56	136	0	0	0	0	0	0	136	56
E-2	0	0	0	0	9	154	0	0	0	0	0	0	154	9
F-1	0	0	0	0	74	16	216	68	0	0	0	0	84	290
F-2	0	0	0	0	119	32	0	0	0	0	0	0	32	119
G-1	0	0	0	0	0	0	110	35	0	0	14	5	40	110
G-2	0	0	0	0	0	0	0	0	28	63	0	0	63	28
G-3	0	0	0	0	0	0	0	0	33	16	0	0	16	33
H-1	0	0	0	0	0	0	0	0	83	54	0	0	54	83
H-2	0	0	0	0	0	0	0	0	138	72	0	0	72	138
H-3	0	0	0	0	0	0	0	0	73	193	0	0	193	73
I-1	0	0	0	0	0	0	74	74	0	0	0	0	74	75
I-2	0	0	0	0	0	0	0	0	66	96	0	0	96	66
I-3	0	0	0	0	0	0	0	0	69	110	0	0	110	69
J-1	0	0	0	0	40	151	0	0	2	10	0	0	162	41
J-2	0	0	0	0	0	0	26	177	24	157	17	0	334	50
J-3	0	0	0	0	0	0	0	0	17	90	0	0	90	17
K	0	0	0	0	0	0	89	413	0	0	0	0	413	89
L	0	0	0	0	70	36	70	102	0	0	0	0	138	141
TOTAL	235	526	562	63	396	638	585	870	534	862	31	5	2,439	2,077

* Natural water bodies, excluding large navigable bayous and actively used man-made canals

Table B-4. Construction impacts of the 100-year alternative under the low SLR scenario.

	Fresh				INT		BR		SAL		Force Drained		Total	Total
100-Yr	Tidal Habitats				Tidal Habitats		Tidal Habitats		Tidal Habitats		(non-tidal)		Tidal	Tidal
Levee	Hwds	Swamp	Marsh	Water*	Marsh	Water*	Marsh	Water*	Marsh	Water*	Marsh	Water*	Water*	Marsh
Reach	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	acres	acres
Barrier	202	547	209	48	0	0	0	0	0	0	0	0	48	209
A	81	13	362	43	0	0	0	0	0	0	0	0	43	362
B	0	0	144	19	39	151	0	0	0	0	0	0	170	182
E-1	0	0	0	0	94	191	0	0	0	0	0	0	191	94
E-2	0	0	0	0	39	216	0	0	0	0	0	0	216	39
F-1	0	0	0	0	84	16	276	78	0	0	0	0	94	359
F-2	0	0	0	0	147	42	0	0	0	0	0	0	42	147
G-1	0	0	0	0	0	0	139	41	0	0	26	7	48	139
G-2	0	0	0	0	0	0	0	0	53	96	0	0	96	53
G-3	0	0	0	0	0	0	0	0	43	29	0	0	29	43
H-1	0	0	0	0	0	0	0	0	112	79	0	0	79	112
H-2	0	0	0	0	0	0	0	0	187	106	0	0	106	187
H-3	0	0	0	0	0	0	0	0	103	119	0	0	119	103
I-1	0	0	0	0	0	0	83	101	0	0	0	0	101	83
I-2	0	0	0	0	0	0	0	0	86	139	0	0	139	86
I-3	0	0	0	0	0	0	0	0	91	144	0	0	144	91
J-1	0	0	0	0	79	216	0	0	2	13	2	0	229	81
J-2	0	0	0	0	0	0	40	300	35	200	28	0	500	75
J-3	0	0	0	0	0	0	0	0	26	123	0	0	123	26
K	0	0	0	0	0	0	139	552	0	0	0	0	552	139
L	0	0	0	0	105	70	107	128	0	0	0	0	197	212
TOTAL	282	560	714	110	586	901	783	1,199	736	1,048	57	7	3,266	2,820

* Natural water bodies, excluding large navigable bayous and actively used man-made canals

Table B-5. Construction impacts of the 100-year alternative under the medium SLR scenario.

100-Yr Levee Reach	Fresh Tidal Habitats				INT Tidal Habitats		BR Tidal Habitats		SAL Tidal Habitats		Force Drained (non-tidal)		Total Tidal	Total Tidal
	Hwds (acres)	Swamp (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Water* acres	Marsh acres
Barrier	202	547	209	48	0	0	0	0	0	0	0	0	48	209
A	81	13	361	43	0	0	0	0	0	0	0	0	43	361
B	0	0	144	20	39	151	0	0	0	0	0	0	170	182
E-1	0	0	0	0	94	191	0	0	0	0	0	0	191	94
E-2	0	0	0	0	39	216	0	0	0	0	0	0	216	39
F-1	0	0	0	0	84	16	276	78	0	0	0	0	95	359
F-2	0	0	0	0	147	42	0	0	0	0	0	0	42	147
G-1	0	0	0	0	0	0	139	41	0	0	26	7	48	139
G-2	0	0	0	0	0	0	0	0	53	96	0	0	96	53
G-3	0	0	0	0	0	0	0	0	43	29	0	0	29	43
H-1	0	0	0	0	0	0	0	0	112	79	0	0	79	112
H-2	0	0	0	0	0	0	0	0	186	107	0	0	107	186
H-3	0	0	0	0	0	0	0	0	102	119	0	0	119	102
I-1	0	0	0	0	0	0	83	101	0	0	0	0	101	83
I-2	0	0	0	0	0	0	0	0	86	139	0	0	139	86
I-3	0	0	0	0	0	0	0	0	91	144	0	0	144	91
J-1	0	0	0	0	79	217	0	0	2	13	2	0	229	81
J-2	0	0	0	0	0	0	40	300	35	200	28	0	500	75
J-3	0	0	0	0	0	0	0	0	26	123	0	0	123	26
K	0	0	0	0	0	0	139	552	0	0	0	0	552	139
L	0	0	0	0	105	70	107	128	0	0	0	0	197	212
TOTAL	282	560	714	111	586	902	783	1,199	736	1,049	57	7	3,267	2,818

* Natural water bodies, excluding large navigable bayous and actively used man-made canals

Table B-6. Construction impacts of the 100-year alternative under the high SLR scenario.

100-Yr Levee Reach	Fresh Tidal Habitats				INT Tidal Habitats		BR Tidal Habitats		SAL Tidal Habitats		Force Drained (non-tidal)		Total Tidal	Total Tidal
	Hwds (acres)	Swamp (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Water* acres	Marsh acres
Barrier	202	547	208	48	0	0	0	0	0	0	0	0	48	208
A	81	13	361	44	0	0	0	0	0	0	0	0	44	361
B	0	0	143	20	39	151	0	0	0	0	0	0	171	182
E-1	0	0	0	0	94	191	0	0	0	0	0	0	191	94
E-2	0	0	0	0	39	216	0	0	0	0	0	0	216	39
F-1	0	0	0	0	83	17	275	79	0	0	0	0	95	358
F-2	0	0	0	0	146	42	0	0	0	0	0	0	42	146
G-1	0	0	0	0	0	0	138	41	0	0	26	7	48	138
G-2	0	0	0	0	0	0	0	0	52	96	0	0	96	52
G-3	0	0	0	0	0	0	0	0	43	29	0	0	29	43
H-1	0	0	0	0	0	0	0	0	112	79	0	0	79	112
H-2	0	0	0	0	0	0	0	0	186	107	0	0	107	186
H-3	0	0	0	0	0	0	0	0	102	120	0	0	120	102
I-1	0	0	0	0	0	0	82	101	0	0	0	0	101	83
I-2	0	0	0	0	0	0	0	0	86	140	0	0	140	86
I-3	0	0	0	0	0	0	0	0	90	144	0	0	144	90
J-1	0	0	0	0	79	217	0	0	2	13	2	0	230	81
J-2	0	0	0	0	0	0	40	300	34	200	28	0	500	75
J-3	0	0	0	0	0	0	0	0	25	123	0	0	123	25
K	0	0	0	0	0	0	138	553	0	0	0	0	553	138
L	0	0	0	0	105	70	106	128	0	0	0	0	198	212
TOTAL	282	560	712	112	584	903	781	1,201	733	1,052	57	7	3,275	2,810

APPENDIX C

SUMMARY OF BASIC MITIGATION LAND REQUIREMENTS BEFORE LAND IS TRANSFERRED TO THE U.S. FISH AND WILDLIFE SERVICE

The following represents a summary of basic mitigation land requirements before land is transferred over to the Service. This does not necessarily represent a comprehensive list, but does represent our best effort to identify all land requirements within reason.

1. For inclusion into the National Wildlife Refuge (NWR) system the lands must be located within a refuge's acquisition boundary.

2. The Service must be provided copies of any easements/agreements for right-of-way on the property especially as it pertains to maintenance of such right-of-way, frequency of maintenance and costs associated with that maintenance if the maintenance is to be performed by the landowner**.** (See also Number 10 below regarding title requirements.)

3. The area must be surveyed prior to acquisition by the United States or transfer to the Fish and Wildlife Service. The survey will be conducted by the Corps of Engineers (Corps) or an approved contractor. Boundaries must be marked and permanent monuments set at all corners. Copies of the surveyor notes, plats, etc. resulting from such survey must be provided to Service. To ensure the adequacy of any proposed survey, Mr. Leon McGee (404/679-7226 or Leon_McGee@fws.gov) and Mr. Kenneth Litzenberger (985/882-2000 or Kenneth_Litzenberger@fws.gov) should be provided for review any plans and specifications or scope-of-services for such surveys.

4. Language must be placed in the deed dedicating the mitigation land to fish and wildlife conservation in perpetuity. To ensure the sufficiency of any such proposed language a copy of that draft language should be provided for review to Ms. Shelia Ford (404/679-7215 or Shelia_Ford@fws.gov) and Mr. Kenneth Litzenberger (985/882-2000 or Kenneth_Litzenberger@fws.gov).

5. When possible any restrictive covenants or liens shall be removed, especially if they could interfere with mitigation implementation, operation and/or maintenance. The Service should be notified of and provided a copy of any such instruments, even if they are removed.

6. If a Level 1 survey has not been completed the Service should be contacted regarding its desire to complete such a survey. If a Level 1 survey for hazardous, toxic, and/or radioactive waste has been completed a copy of that survey should be provided to the Service.

If the Level 1 survey indicates the need for further investigations/surveys, those investigations/surveys must be completed and a copy provided to the Service. Lands having unremediated hazardous, toxic, and/or radioactive wastes present may not be accepted into a NWR. Remediated sites will be assessed for inclusion on a case-by-case basis. Documentation of the level of remediation is to be provided to the Service.

7. Funding mechanism for operation and maintenance of the mitigation lands and mitigation features (e.g., water control structures, timber stand improvements, etc.). A copy of the proposed method of transferring funds for operations and maintenance and proposed amount to be transferred should be provided to Mr. Kenneth Litzenberger (985/882-2000 or

Kenneth_Litzenberger@fws.gov) for review and comment.

8. Documentation must be provided to the Service describing the mitigation goals and objectives in addition to a description of necessary operation and maintenance activities needed to accomplish the stated goals and objectives.

9. Mineral rights should be purchased. If it is not possible to purchase, then protection of surface rights via the following language:

> "The vendors reserve for themselves, their successors and assigns, the right to explore, for, operate, produce, remove and transport, oil and gas from the lands herein described. The vendors reserve unto themselves, their successors and assigns, the right of ingress and egress over the said lands in pursuance of the reservations set forth above.
>
> The land is now subject to oil and gas lease in favor of ____, as per lease of record in the records of ______________________, __________________________, pages ______________ of Book __________________, and the conveyance is subject to the rights of the lessee in said lease.
>
> The oil and gas reservations made by the vendors herein in favor of themselves, their successors and assigns, shall be subject to the following stipulations, and any lease made by the vendors, their successors or assigns, subsequent to the date of this deed, shall contain the following stipulations for the protection of the vendee.
>
> The vendors, their successors and assigns, agree that prior to entry upon the land for purposes of exploration, development or production of, oil and/or gas, they shall obtain a Special Use Permit from the U.S. Fish and Wildlife Service, which permit is for the purpose of providing for access and protecting the natural resources of the area for which the land was acquired, and whose terms and conditions will not unreasonably restrain the activities of the vendors, and their successors and assigns.
>
> It is mutually understood between the parties that the intention of the Government in acquiring this area is to create a refuge for, and the protection of, wildlife in the area herein acquired, and the vendors will conform to, and be governed by, and the vendors herein bind themselves, their successors and assigns, agents and employees, to conform to, and be governed by, the rules and regulations pertaining to the protection of wildlife and refuge administration prescribed from time to time by the Secretary of the Interior or his/her authorized agent, the Director of Fish and Wildlife Service, except that such regulations shall not unreasonably restrain the exercise and use by the vendors, their successors and assigns, of the reservation set out in this agreement."

10. The Service would need a title commitment and policy in favor of United States of America that is in the American Land Title Association (ALTA) U.S. Policy 9/28/91 format as provided in Title Standards 2001.

11. Title Insurance in the name of the United States of America and for the appraised land value should be purchased.

If the title remains with the local-sharer or the Corps a General Plan as provided for under Section 3 of the Fish and Wildlife Coordination Act (48 Stat. 401; 16 U.S.C. 661 et seq.) must be written. However, the Service may chose to not manage lands for which it does not have title.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

December 6, 2012

Colonel Edward R. Fleming
District Commander
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Fleming:

Please reference the Post-Authorization Change (PAC) report being prepared to quantify costs and impacts of the Morganza, Louisiana, to the Gulf of Mexico Hurricane Protection Project (MTG) authorized under the 2007 Water Resources Development Act. That PAC report will examine the feasibility, costs, and impacts associated with two levee height alternatives, both of which are located on the alignment selected in the 2002 Feasibility Report. The PAC alternatives would protect against flooding from a 1 percent annual chance of occurrence storm (100-year frequency) and a 3 percent annual chance of occurrence storm (35-year frequency). The PAC report will programmatically evaluate most project features; however, feasibility level evaluations are desired for the "constructable" features which include levee reaches F1, F2, and G1, plus the Houma Navigation Canal (HNC) Lock Complex and the Bayou Grand Caillou Floodgate.

Since the release of the 2002 Feasibility Report, additional levee reaches have been added to both the eastern and western ends of the proposed MTG levee system. This Supplemental Coordination Act Report updates the direct impact assessments and recommendations contained in the U.S. Fish and Wildlife Service (Service) May 2012 Draft Fish and Wildlife Coordination Act Report (included herein by reference) to include the direct impacts for those new levee reaches. Consequently, the recommendations and direct impacts herein supersede those in our May 2012 Coordination Act Report. However, because of very recent changes in the operation of proposed floodgates, the assessment of indirect impacts must be revised. Given the extent and complexity of the needed additional impact assessments, the Service is not able to complete the indirect impact assessments for the constructable features within the current study schedule.

Given that the indirect impact assessments for the constructable features are incomplete, and that the direct construction impacts for the remaining levee features are of only a programmatic assessment level, this Supplemental Coordination Act Report does not fulfill the requirements of the Fish and Wildlife Coordination Act and does not constitute the final report of the Secretary of the Interior as required by Section 2(b) of that Act. However, when the indirect impact analyses for the constructable featues are completed and finalized, then a final report of the Secretary of the Interior can be prepared and submitted for the constructable features, as required by Section 2(b) of that Act. This report has been provided to the National Marine Fisheries Service and the

Louisiana Department of Wildlife and Fisheries. Their comments on this report will be incorporated into our final report.

Programmatic-level estimates of wetland impacts due to levee construction (see Appendix A) have been estimated using 2008 National Wetland Inventory (NWI) data and levee footprint shapefiles provided by the U.S. Army Corps of Engineers (Corps). Given the resolution of the NWI data, habitat type misclassification errors, and post 2008 habitat changes, the Service believes that the NWI data is not sufficiently accurate for future feasibility impact assessments in forested wetlands subject to development. The Service recommends that future feasibility impact analyses for MTG levee segments should utilize current aerial imagery and associated ground truthing to determine the types and acreage of non-marsh habitat impacts. Because direct impacts for the constructable features are primarily marsh habitats, we believe that those acreage estimates are of sufficient detail for a feasibility level analysis.

Initially, closure of the MTG floodgates and structures was planned whenever tropical storm events raised water levels to + 3.0 ft NAVD88 or higher. Consequently, cumulative closure duration would be based primarily on tropical storm frequency which the Habitat Evaluation Team (HET) assumed would remain at a constant average of 1.5 days per year. However, the Corps changed the closure criteria such that all MTG floodgates and structures (except the HNC Lock Complex and the Bayou Grand Caillou floodgate) will be closed whenever stages reach or exceed +2.5 ft NAVD88, regardless of the cause. Because of potential future sea level rise, the revised operational criteria may result in increasing closure frequency and duration over time, and corresponding increases in fisheries access impacts. Because stages are generally higher on the eastern side of the MTG project, recent stage data is needed from gages in the vicinity of those east side structures to properly assess the duration of MTG east side gate closures with future sea level rise.

Closure criteria for the HNC Lock Complex include an Atchafalaya River discharge less than or equal to 100,000 cubic feet per second (cfs), or, HNC Dulac salinities of 7.5 parts per thousand (ppt) or greater. Because of potential future sea level rise, regional salinities may increase over time. Consequently, lock closures to preclude saltwater impacts are expected to occur more frequently over time. The HET plans to use model-predicted salinities to assess salinity increases and associated lock closure durations. However, predicted salinity data are not yet available for the low sea level rise scenario at target year 50. The HET will need those predicted salinities to assess closure durations under the low sea level rise scenario.

The Corps has proposed a salinity of 13.0 ppt in Bayou Petit Caillou at Cocodrie, as the criterion for re-opening the HNC Lock Complex. Because salinity data has not been collected at that location, the HET cannot determine whether that is a suitable criterion, and hence, uncertainty exists regarding the duration of HNC Lock saltwater closures. Alternative criteria should be supplied to facilitate an accurate assessment of saltwater closure durations and associated fisheries access impacts.

HNC Lock closures to reduce saltwater intrusion up the HNC may reduce salinities north of the lock and may provide some wetland benefits. Wetland benefits associated with salinity reductions should be incorporated into the Wetland Value Assessments (WVAs) conducted to assess indirect impacts on enclosed marshes. That salinity data should be made available so the HET can incorporate salinity change effects into the assessment of overall indirect effects of the constructable features.

Construction of the HNC has created a large and very efficient north-south channel which has greatly increased tidal exchange and saltwater intrusion in the marshes and former bald cypress swamps located between Bayou DuLarge and Bayou Grand Caillou. Hydrologic impacts of the HNC have also extended into the southwestern Lake Boudreaux Basin due to the influence of Bayou Grand Caillou. Because construction of the HNC has resulted in adverse impacts to hydrology and affected wetlands, the Service is not opposed to periodic HNC closures to reduce or preclude saltwater intrusion up the HNC. In addition to helping protect Houma's drinking water supply from saltwater contamination, the Service hopes that the proposed saltwater closures might help to maintain and restore coastal cypress swamps in that area, which were severely impacted by HNC-induced saltwater intrusion. Given the environmental damage caused by the HNC, and the fact that it is an artificial channel which has increased fisheries access, the Service does not believe that periodic closures of the HNC should be considered as causing fisheries access impacts, provided that the Bayou Grand Caillou floodgate remains open. Additionally, we believe that lock closure will result in compensatory water exchange increases via Bayou Grand Caillou and other channels and those increases should be considered when fisheries access impacts are determined.

HET representatives from the National Marine Fisheries Service, the Louisiana Department of Wildlife and Fisheries, and Coastal Protection and Restoration Authority do not concur with the Service's assumption that the HNC saltwater closures should not reduce fisheries access below the optimal level. They would prefer to apply fisheries access penalties for both the percent of HNC cross-section reduction due to HNC Lock Complex installation, and the percent of time the HNC Lock is closed. The Service believes that progress toward resolving this disagreement can be made through use of model-generated tidal flux estimates to quantify the extent to which project floodgates and structures would reduce tidal exchange. Consequently, the Service requests that this information be made available.

Previous hydrologic modeling runs used to assess indirect impacts have evaluated scenarios where either all structures were open year-round or all closed year-round. To more accurately assess proposed structure operations, the Service requests that runs be conducted using the proposed structure operation plans.

Of the two alternative plans evaluated under this Feasibility Study, the Corps has selected the 100-yr frequency storm protection alternative. Based on the Corps-provided construction schedule, and using the medium sea level rise (SLR) scenario, our programmatic-level assessment indicates that construction impacts of the Tentatively Selected Plan would result in a loss of 520 acres of bottomland hardwood forest, 599 acres of cypress swamp, and 2,993 acres of marsh. Because detailed engineering and design is not available for most levee reaches and structures, only levee reaches F1, F2, G1, the HNC Lock and the Bayou Grand Caillou Floodgate will be proposed for construction authorization. Construction of those levee reaches and structures would result in the direct loss of 670 acres of marsh and -390.5 Average Annual Habitat Units (AAHUs) over the project life. Those impacts would be mitigated by creating 137 acres of intermediate marsh and 776 acres of brackish marsh. Additional indirect impacts will result from the constructable features, but those indirect impacts have not yet been quantified.

Because of the complexity and scope of this study, many details regarding the design and operation of project features must be addressed during the post-authorization phase; hence, precise estimates of project-related impacts/benefits associated with all project features cannot be provided until the designs of all project features are finalized. Because designs for several critical floodgates have not yet been completed, the assessment of local and system-wide hydrology effects cannot yet be concluded and additional hydrologic impact assessments will be needed.

Extensive coordination between the Corps and the Service will be required throughout the post-authorization phase to ensure that impacts to coastal wetlands and associated fish and wildlife resources are avoided and minimized to the greatest degree possible and that adequate and effective mitigation measures are implemented to compensate for unavoidable impacts.

Substantial direct wetland losses will result from construction of project features. Consequently, avoidance and minimization of direct wetland impacts should be pursued to the greatest extent practicable. The Service does not oppose the implementation of the constructable features and provides the following recommendations to avoid and/or minimize project impacts on fish and wildlife resources, and for mitigating unavoidable impacts to those resources.

1. The Post Authorization Change Report, in keeping with the project's Congressional Authorization, should clearly reiterate that features of the Tentatively Selected Plan will be designed to maintain existing freshwater inflows from the Atchafalaya River via the Gulf Intracoastal Waterway. Those designs shall accommodate restoration needs determined via future restoration planning, to the extent possible. The Service also recommends that the Corps provide the Service with the opportunity to review and comment on model assumptions and input data prior to initiating the modeling analyses necessary to complete those tasks. Tasks should include the following:

    a. Future design of the Grand Bayou Floodgate should accommodate southward freshwater flows.
    b. Construction of Reach L and K levees should avoid use of material dredged from Grand Bayou Canal and from the Cutoff Canal so that saltwater intrusion via those channels is not increased.
    c. The eastern Gulf Intracoastal Waterway (GIWW) floodgate should have the smallest possible cross-section to reduce the loss of Atchafalaya River freshwater to the Barataria Basin and to retain that freshwater within the Terrebonne Basin.
    d. The design of the west GIWW floodgate should avoid stage increases west of that structure and should be capable of passing Atchafalaya River freshwater flows, especially during periods of high Atchafalaya River stages, without any loss of flow.
    e. The two environmental water control structures along Falgout Canal should be designed and operated to only discharge freshwater southward and not to allow

northward flow of saltwater into Falgout Canal.

2. The Corps should coordinate closely with the Service and other fish and wildlife conservation agencies throughout the engineering and design of project features including levees, floodgates, and environmental water control structures to ensure that those features are designed, constructed and operated consistent with wetland restoration purposes and associated fish and wildlife resource needs.

3. Operational plans for floodgates and water control structures, excluding the Falgout Canal environmental structures, the HNC Lock Complex, and the east GIWW floodgate, should be developed to maximize the open cross-sectional area for as long as possible. Operations to maximize freshwater retention or redirect freshwater flows could be considered if hydraulic modeling demonstrates that is possible and such actions are recommended by the natural resource agencies. Development of water control structure operation manuals or plans should be done in coordination with the Service and other natural resource agencies.

4. To the greatest extent possible, the Bayou Grand Caillou floodgate should remain open during HNC Lock Complex saltwater closure periods to maintain water exchange in this natural bayou and thereby reduce or avoid impacts to fish access.

5. The location of the Barrier Reach, Reach A, and the Larose to Lockport levees should be modified to reduce direct wetland impacts and enclosure of wetlands, to the degree possible. Features such as spoil bank gapping or other measures should also be added to avoid impacts to enclosed wetlands due to unintentional impaired drainage. The Corps should coordinate with the Service and other natural resource agencies to develop the best approach for avoiding drainage impacts.

6. Estimates of all direct and indirect project-related wetland impacts, including those associated with changes in freshwater inflows and distribution, should be refined during the engineering and design phase, including impacts associated with the proposed HNC Lock closures to preclude saltwater intrusion.

7. To determine acreage of forested habitat types impacted by future levee construction activities, those acreages should be obtained by digitizing current aerial imagery and ground truthing, rather than through use of 2008 NWI data.

8. To the greatest degree practical, the hurricane protection levees and borrow pits should be located to avoid and minimize direct and indirect impacts to emergent wetlands. Efforts should be made to further reduce those direct impacts by hauling in fill material, using sheetpile for the levee crest, deep soil mixing, or other alternatives.

9. When organic soils must be removed from the construction site, that material should be used to create or restore emergent wetlands to the greatest extent practicable. If that is not practicable, then use of that material to improve borrow

pit habitat quality (e.g., construct bank slopes, reduce depths, etc.) should be examined.

10. Forest clearing associated with project features should be conducted during the fall or winter to minimize impacts to nesting migratory birds, when practicable.

11. Avoid adverse impacts to bald eagle nesting locations and wading bird colonies through careful design of project features and timing of construction. Surveys prior to construction should be undertaken by the construction agency to ensure no nesting birds are within 1,000 feet of any proposed work. If nesting birds are found within 1,000 feet of any proposed work sites, the Service and the Louisiana Department of Wildlife and Fisheries should be contacted for procedures to avoid impacts.

12. Full, in-kind compensation (quantified as AAHUs) should be provided for unavoidable net adverse impacts on forested wetlands, marsh, and associated submerged aquatic vegetation, including any additional losses identified during post-authorization engineering and design studies. To help ensure that the proposed mitigation features meet their goals, the Service provides the following recommendations.

    a. Mitigation measures should be constructed concurrently with the features that they are mitigating (i.e., mitigation should be completed no later than 18 months after levee construction has begun. Completion of mitigation means that initial fill elevations have been achieved. If mitigation is provided via an in-lieu fee program, completed mitigation would be achieved when credits were purchased from an approved mitigation bank.
    b. Proposed mitigation in the open water area south of Falgout Canal (in subunit B13) should be coordinated with ongoing Corps Regulatory Branch mitigation plans to avoid conflicts.
    c. In coordination with the Service and other fish and wildlife conservation agencies, the Corps should address the Environmental Protection Agency's 12 requirements for each mitigation measure (Appendix B).
    d. Mitigation performance should be assessed using the draft performance criteria used by the Corps and natural resource agencies for the Hurricane Storm Damage Risk Reduction Study.
    e. The Service and other fish and wildlife conservation agencies should be consulted in the development of plans and specifications for all mitigation features and any monitoring and/or adaptive management plans.
    f. Unavoidable impacts to wetlands within Mandalay National Wildlife Refuge should be mitigated on the refuge.
    g. The acreage of marsh created to mitigate project impacts should meet or exceed the marsh acreage projected by the Habitat Evaluation Team for target year 5. If deficiencies occur in year 5 acres, additional mitigation shall be provided.
    h. To avoid shortfalls in marsh creation acreage, the contractor should be

required to guarantee the creation of at least the target acreage of marsh platform, or excess acres should be created.

i. The acreage of marsh created for mitigation purposes, and adjacent affected wetlands, should be monitored over the project life to evaluate project impacts, the effectiveness of compensatory mitigation measures, and the need for additional mitigation should those measures prove insufficient.

j. Dredged material borrow pits, including those utilized to create marsh for mitigation purposes, should be carefully designed and located to minimize anoxia problems and excessive disturbance to area water bottoms, and to avoid increased saltwater intrusion.

k. If applicable, a General Plan should be developed by the Corps, the Service, and the managing natural resource agency in accordance with Section 3(b) of the Fish and Wildlife Coordination Act for mitigation lands.

13. Additional information is needed by the Service to complete the required evaluation of project effects and fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act. Much of that information will not be available until engineering and design of the project features has progressed. To help ensure that sufficient information is provided, the Service recommends that the Corps perform the following tasks during the engineering and design phase.

    1. Provide additional information on anticipated construction techniques and their associated wetland impacts, such as additional dredging to install floodgates and water control structures, dredging temporary by-pass channels, and the method for disposing organic surface soils that are unsuitable for levee construction.
    2. Provide final locations and designs for borrow sites used in levee construction.

14. Funding should be provided for full Service participation in the post-authorization engineering and design studies, and to facilitate fulfillment of its responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act.

15. The Corps should obtain a right-of-way from the Service prior to conducting any work on Mandalay National Wildlife Refuge, in conformance with Section 29.21-1, Title 50, Right-of-Way Regulations. Issuance of a right-of-way will be contingent on a determination by the Service's Regional Director that the proposed work will be compatible with the purposes for which the Refuge was established.

16. All construction or maintenance activities (e.g., surveys, land clearing, etc.) on Mandalay National Wildlife Refuge (NWR) will require the Corps to obtain a Special Use Permit from the Refuge Manager; furthermore, all activities on that NWR must be coordinated with the Refuge Manager. Therefore, we recommend that the Corps request issuance of a Special Use Permit well in advance of conducting any work on the refuge. Please contact the Refuge Manager (985/853-1078) for further information on compatibility of flood control features,

and for assistance in obtaining a Special Use Permit. Close coordination by both the Corps and its contractor must be maintained with the Refuge Manager to ensure that construction and maintenance activities are carried out in accordance with provisions of any Special Use Permit issued by the NWR.

17. If mitigation lands are purchased for inclusion within a NWR, those lands must meet certain requirements. A summary of some of those requirements was provided in appendix C to our May 2012 Coordination Act Report. Other land-managing natural resource agencies may have similar requirements that must be met prior to accepting mitigation lands; therefore, if an agency is proposed as a manager of a mitigation site, they should be contacted early in the planning phase regarding such requirements.

18. The Corps should contact the Louisiana Department of Wildlife and Fisheries prior to conducting any work on Point au Chene Wildlife Management Area (985-594-5494).

To fully evaluate indirect impacts of MTG structure operations on enclosed wetlands and fisheries access, the Service provides the following recommendations regarding information needed to conduct a full assessment of indirect project impacts and benefits.

1. Because stages are generally higher along the more exposed MTG east side, historic stage data (in NAVD88) from locations near proposed MTG east-side floodgates should be provided to the Service to facilitate prediction of future closure durations for floodgates along the MTG east side.

2. Hydraulic modeling to predict project effects on future salinities has been conducted but not for a scenario incorporating the proposed saltwater closures of the HNC Lock Complex, nor the planned freshwater introduction operations of the Falgout Canal environmental water control structures. If possible, the Corps should conduct such model runs to enable a more accurately assessment of the effects of the proposed project feature operations, rather than using model runs with all structures closed or open.

3. Hydraulic model runs to predict salinities at target year 50 year were conducted for the medium and high sea level rise scenarios, but not for the low sea level rise scenario. Model runs should also be conducted to predict salinities at target year 50 for the low sea level rise scenario.

4. Predicted average subunit salinities are needed to evaluate project-induced salinity change effects. Those model runs should be completed and results provided to the Service. Runs should be conducted for all sea level rise scenarios and should include baseline salinity conditions and future without project salinities at target year 50, plus future with project salinities at target year 1 and target year 50.

5. Model-generated tidal flux outputs should be made available to assist in quantifying project-related water exchange reductions and associated fisheries access impacts.

Given that design and evaluation of most project features has been at a programmatic level, the Service cannot fulfill its Coordination Act responsibilities at this time. For the constructable features, we hope to complete the assessment of impacts in time for inclusion in the Final Environmental Impact Statement. To complete those assessments, we may require additional funding during the next several months. Estimates of those funding needs should be coordinated in advance with the Service, and should be based on the nature and complexity of issues associated with the project design and implementation.

Provided that the above recommendations are included in the feasibility report and related authorizing documents, the Service does not oppose further planning and implementation of the TSP. If you have any questions regarding the above information, please contact Mr. Ronny Paille of this office (337-291-3117).

Sincerely,

Jeffrey D. Weller
Supervisor
Louisiana Ecological Services Office

cc: SE Refuges, Bayou LaCombe, LA
EPA, Dallas, TX
NMFS, Baton Rouge, LA
LA Dept. of Wildlife and Fisheries, Baton Rouge, LA
LA Dept. of Natural Resources (CMD), Baton Rouge, LA
LA OCPR, Baton Rouge, LA

APPENDIX A

DIRECT CONSTRUCTION IMPACTS BY LEVEE REACH AND HABITAT TYPE

Table A-1. Construction impacts of the 35-year alternative under the low SLR scenario.

35-Yr Levee Reach	Fresh Tidal Habitats				INT Tidal Habitats		BR Tidal Habitats		SAL Tidal Habitats		Force Drained (non-tidal)		Total Tidal	Total Tidal
	Hwds (acres)	Swamp (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water (acres)	Water* acres	Marsh acres
Barrier	170	475	157	6	0	0	0	0	0	0	0	0	6	157
A	65	51	306	39	0	0	0	0	0	0	0	0	39	306
B	0	0	103	15	27	112	0	0	0	0	0	37	127	130
E-1	0	0	0	0	56	136	0	0	0	0	0	0	136	56
E-2	0	0	0	0	9	154	0	0	0	0	0	1	154	9
F-1	0	0	0	0	75	16	217	68	0	0	0	0	83	291
F-2	0	0	0	0	120	32	0	0	0	0	0	0	32	120
G-1	0	0	0	0	0	0	111	35	0	0	14	5	35	111
G-2	0	0	0	0	0	0	0	0	29	63	0	0	63	29
G-3	0	0	0	0	0	0	0	0	33	16	0	0	16	33
H-1	0	0	0	0	0	0	0	0	83	53	0	0	53	83
H-2	0	0	0	0	0	0	0	0	138	72	0	0	72	138
H-3	0	0	0	0	0	0	0	0	74	193	0	0	193	74
I-1	0	0	0	0	0	0	74	73	0	0	0	0	74	75
I-2	0	0	0	0	0	0	0	0	66	95	0	1	95	66
I-3	0	0	0	0	0	0	0	0	69	110	0	0	110	69
J-1	0	0	0	0	40	151	0	0	2	10	0	0	162	42
J-2	0	0	0	0	0	0	26	177	25	157	17	1	334	50
J-3	0	0	0	0	0	0	0	0	18	90	0	0	90	18
K	0	0	0	0	0	0	89	413	0	0	0	0	413	89
L	0	0	0	0	71	35	71	102	0	0	0	5	137	142
LG	24	0	0	0	19	1	0	0	0	0	0	11	1	19
LL	171	36	86	0	0	0	0	0	0	0	0	3	0	86
TOTAL	430	562	652	59	416	637	587	868	537	860	31	66	2,424	2,192

Table A-2. Construction impacts of the 35-year alternative under the medium SLR scenario.

35-Yr Levee Reach	Fresh Tidal Habitats				INT Tidal Habitats		BR Tidal Habitats		SAL Tidal Habitats		Force Drained (non-tidal)		Total Tidal	Total Tidal
	Hwds (acres)	Swamp (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water (acres)	Water* acres	Marsh acres
Barrier	170	475	157	6	0	0	0	0	0	0	0	0	6	157
A	65	51	305	39	0	0	0	0	0	0	0	0	39	305
B	0	0	103	15	27	112	0	0	0	0	0	37	127	130
E-1	0	0	0	0	56	136	0	0	0	0	0	0	136	56
E-2	0	0	0	0	9	154	0	0	0	0	0	1	154	9
F-1	0	0	0	0	75	16	217	68	0	0	0	0	84	291
F-2	0	0	0	0	120	32	0	0	0	0	0	0	32	120
G-1	0	0	0	0	0	0	111	35	0	0	14	5	35	111
G-2	0	0	0	0	0	0	0	0	29	63	0	0	63	29
G-3	0	0	0	0	0	0	0	0	33	16	0	0	16	33
H-1	0	0	0	0	0	0	0	0	83	53	0	0	53	83
H-2	0	0	0	0	0	0	0	0	138	72	0	0	72	138
H-3	0	0	0	0	0	0	0	0	74	193	0	0	193	74
I-1	0	0	0	0	0	0	74	74	0	0	0	0	74	75
I-2	0	0	0	0	0	0	0	0	66	95	0	1	95	66
I-3	0	0	0	0	0	0	0	0	69	110	0	0	110	69
J-1	0	0	0	0	40	151	0	0	2	10	0	0	162	42
J-2	0	0	0	0	0	0	26	177	24	157	17	1	334	50
J-3	0	0	0	0	0	0	0	0	18	90	0	0	90	18
K	0	0	0	0	0	0	89	413	0	0	0	0	413	89
L	0	0	0	0	71	35	71	102	0	0	0	5	137	142
LG	24	0	0	0	19	1	0	0	0	0	0	11	1	19
LL	171	36	86	0	0	0	0	0	0	0	0	3	0	86
TOTAL	430	562	651	60	416	637	587	868	536	860	31	66	2,426	2,190

Table A-3. Construction impacts of the 35-year alternative under the high SLR scenario.

35-Yr	Fresh Tidal Habitats				INT Tidal Habitats		BR Tidal Habitats		SAL Tidal Habitats		Force Drained (non-tidal)		Total Tidal	Total Tidal
Levee Reach	Hwds (acres)	Swamp (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water (acres)	Water* acres	Marsh acres
Barrier	170	475	156	8	0	0	0	0	0	0	0	0	8	156
A	65	51	303	41	0	0	0	0	0	0	0	0	41	303
B	0	0	103	15	27	113	0	0	0	0	0	37	127	130
E-1	0	0	0	0	56	136	0	0	0	0	0	0	136	56
E-2	0	0	0	0	9	154	0	0	0	0	0	1	154	9
F-1	0	0	0	0	74	16	216	68	0	0	0	0	84	290
F-2	0	0	0	0	119	32	0	0	0	0	0	0	32	119
G-1	0	0	0	0	0	0	110	35	0	0	14	5	35	110
G-2	0	0	0	0	0	0	0	0	28	63	0	0	63	28
G-3	0	0	0	0	0	0	0	0	33	16	0	0	16	33
H-1	0	0	0	0	0	0	0	0	83	54	0	0	54	83
H-2	0	0	0	0	0	0	0	0	138	72	0	0	72	138
H-3	0	0	0	0	0	0	0	0	73	193	0	0	193	73
I-1	0	0	0	0	0	0	74	74	0	0	0	0	74	75
I-2	0	0	0	0	0	0	0	0	66	96	0	1	96	66
I-3	0	0	0	0	0	0	0	0	69	110	0	0	110	69
J-1	0	0	0	0	40	151	0	0	2	10	0	0	162	41
J-2	0	0	0	0	0	0	26	177	24	157	17	1	334	50
J-3	0	0	0	0	0	0	0	0	17	90	0	0	90	17
K	0	0	0	0	0	0	89	413	0	0	0	0	413	89
L	0	0	0	0	70	36	70	102	0	0	0	5	138	141
LG	24	0	0	0	19	1	0	0	0	0	0	11	1	19
LL	171	36	86	0	0	0	0	0	0	0	0	3	0	86
TOTAL	235	526	562	63	396	638	585	870	534	863	31	52	2,434	2,181

Table A-4. Construction impacts of the 100-year alternative under the low SLR scenario.

100-Yr	Fresh Tidal Habitats				INT Tidal Habitats		BR Tidal Habitats		SAL Tidal Habitats		Force Drained (non-tidal)		Total Tidal	Total Tidal
Levee Reach	Hwds (acres)	Swamp (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water (acres)	Water* acres	Marsh acres
Barrier	202	547	209	48	0	0	0	0	0	0	0	0	48	209
A	81	13	362	43	0	0	0	0	0	0	0	0	43	362
B	0	0	144	19	39	151	0	0	0	0	0	39	170	182
E-1	0	0	0	0	94	191	0	0	0	0	0	0	191	94
E-2	0	0	0	0	39	216	0	0	0	0	0	4	216	39
F-1	0	0	0	0	84	16	276	78	0	0	0	0	94	359
F-2	0	0	0	0	147	42	0	0	0	0	0	0	42	147
G-1	0	0	0	0	0	0	139	41	0	0	26	0	41	139
G-2	0	0	0	0	0	0	0	0	53	96	0	0	96	53
G-3	0	0	0	0	0	0	0	0	43	29	0	0	29	43
H-1	0	0	0	0	0	0	0	0	112	79	0	0	79	112
H-2	0	0	0	0	0	0	0	0	187	106	0	0	106	187
H-3	0	0	0	0	0	0	0	0	103	119	0	0	119	103
I-1	0	0	0	0	0	0	83	101	0	0	0	0	101	83
I-2	0	0	0	0	0	0	0	0	86	139	0	1	139	86
I-3	0	0	0	0	0	0	0	0	91	144	0	0	144	91
J-1	0	0	0	0	79	216	0	0	2	13	2	1	229	81
J-2	0	0	0	0	0	0	40	300	35	200	28	2	500	75
J-3	0	0	0	0	0	0	0	0	26	123	0	4	123	26
K	0	0	0	0	0	0	139	552	0	0	0	0	552	139
L	0	0	0	0	105	70	107	128	0	0	0	7	197	212
LG	51	0	0	0	30	1	0	0	0	0	0	18	1	30
LL	187	39	89	0	0	0	0	0	0	0	0	3	0	89
TOTAL	520	599	803	110	616	902	783	1,199	736	1,048	57	80	3,260	2,939

Table A-5. Construction impacts of the 100-year alternative under the medium SLR scenario.

100-Yr Levee Reach	Fresh Tidal Habitats				INT Tidal Habitats		BR Tidal Habitats		SAL Tidal Habitats		Force Drained (non-tidal)		Total Tidal	Total Tidal
	Hwds (acres)	Swamp (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water (acres)	Water* acres	Marsh acres
Barrier	202	547	209	48	0	0	0	0	0	0	0	0	48	209
A	81	13	361	43	0	0	0	0	0	0	0	0	43	361
B	0	0	144	20	39	151	0	0	0	0	0	39	170	182
E-1	0	0	0	0	94	191	0	0	0	0	0	0	191	94
E-2	0	0	0	0	39	216	0	0	0	0	0	4	216	39
F-1	0	0	0	0	84	16	276	78	0	0	0	0	95	359
F-2	0	0	0	0	147	42	0	0	0	0	0	0	42	147
G-1	0	0	0	0	0	0	139	41	0	0	26	0	41	139
G-2	0	0	0	0	0	0	0	0	53	96	0	0	96	53
G-3	0	0	0	0	0	0	0	0	43	29	0	0	29	43
H-1	0	0	0	0	0	0	0	0	112	79	0	0	79	112
H-2	0	0	0	0	0	0	0	0	186	107	0	0	107	186
H-3	0	0	0	0	0	0	0	0	102	119	0	0	119	102
I-1	0	0	0	0	0	0	83	101	0	0	0	0	101	83
I-2	0	0	0	0	0	0	0	0	86	139	0	1	139	86
I-3	0	0	0	0	0	0	0	0	90	144	0	0	144	90
J-1	0	0	0	0	79	217	0	0	2	13	2	1	229	81
J-2	0	0	0	0	0	0	40	300	34	200	28	2	500	75
J-3	0	0	0	0	0	0	0	0	26	123	0	4	123	26
K	0	0	0	0	0	0	139	552	0	0	0	0	552	139
L	0	0	0	0	105	70	107	128	0	0	0	7	197	212
LG	51	0	0	0	30	1	0	0	0	0	0	18	1	30
LL	187	39	89	0	0	0	0	0	0	0	0	3	0	89
TOTAL	520	599	802	111	616	903	783	1,199	735	1,049	57	80	3,262	2,936

Table A-6. Construction impacts of the 100-year alternative under the high SLR scenario.

100-Yr Levee Reach	Fresh Tidal Habitats				INT Tidal Habitats		BR Tidal Habitats		SAL Tidal Habitats		Force Drained (non-tidal)		Total Tidal	Total Tidal
	Hwds (acres)	Swamp (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water (acres)	Water* acres	Marsh acres
Barrier	202	547	208	48	0	0	0	0	0	0	0	0	48	208
A	81	13	361	44	0	0	0	0	0	0	0	0	44	361
B	0	0	143	20	39	151	0	0	0	0	0	39	171	182
E-1	0	0	0	0	94	191	0	0	0	0	0	0	191	94
E-2	0	0	0	0	39	216	0	0	0	0	0	4	216	39
F-1	0	0	0	0	83	17	275	79	0	0	0	0	95	358
F-2	0	0	0	0	146	42	0	0	0	0	0	0	42	146
G-1	0	0	0	0	0	0	138	41	0	0	26	0	41	138
G-2	0	0	0	0	0	0	0	0	52	96	0	0	96	52
G-3	0	0	0	0	0	0	0	0	43	29	0	0	29	43
H-1	0	0	0	0	0	0	0	0	112	79	0	0	79	112
H-2	0	0	0	0	0	0	0	0	186	107	0	0	107	186
H-3	0	0	0	0	0	0	0	0	102	120	0	0	120	102
I-1	0	0	0	0	0	0	82	101	0	0	0	0	101	83
I-2	0	0	0	0	0	0	0	0	86	140	0	1	140	86
I-3	0	0	0	0	0	0	0	0	90	144	0	0	144	90
J-1	0	0	0	0	79	217	0	0	2	13	2	1	230	81
J-2	0	0	0	0	0	0	40	300	34	200	28	2	500	75
J-3	0	0	0	0	0	0	0	0	25	123	0	4	123	25
K	0	0	0	0	0	0	138	553	0	0	0	0	553	138
L	0	0	0	0	105	70	106	128	0	0	0	7	198	212
LG	51	0	0	0	30	1	0	0	0	0	0	18	1	30
LL	187	39	89	0	0	0	0	0	0	0	0	3	0	89
TOTAL	520	599	801	112	614	905	781	1,201	733	1,052	57	80	3,270	2,928

APPENDIX B

TWELVE REQUIRMENTS FOR MITIGATION PLANNING
(from the U.S. Army Corps of Engineers & EPA 2008 Final Mitigation Rule in the FEDERAL REGISTER Vol. 73, No. 70, April 10, 2008)

Twelve Requirements for a Compensatory Mitigation Plan

1. Objectives. A description of the resource type(s) and amount(s) that will be provided, the method of compensation (restoration, establishment, preservation etc.), and how the anticipated functions of the mitigation project will address watershed needs.

2. Site selection. A description of the factors considered during the site selection process. This should include consideration of watershed needs, onsite alternatives where applicable, and practicability of accomplishing ecologically self-sustaining aquatic resource restoration, establishment, enhancement, and/or preservation at the mitigation project site.

3. Site protection instrument. A description of the legal arrangements and instrument including site ownership, that will be used to ensure the long-term protection of the mitigation project site.

4. Baseline information. A description of the ecological characteristics of the proposed mitigation project site, in the case of an application for a DA permit, the impact site. This may include descriptions of historic and existing plant communities, historic and existing hydrology, soil conditions, a map showing the locations of the impact and mitigation site(s) or the geographic coordinates for those site(s), and other characteristics appropriate to the type of resource proposed as compensation. The baseline information should include a delineation of waters of the United States on the proposed mitigation project site. A prospective permittee planning to secure credits from an approved mitigation bank or in-lieu fee program only needs to provide baseline information about the impact site.

5. Determination of credits. A description of the number of credits to be provided including a brief explanation of the rationale for this determination.
   - For permittee-responsible mitigation, this should include an explanation of how the mitigation project will provide the required compensation for unavoidable impacts to aquatic resources resulting from the permitted activity.
   - For permittees intending to secure credits from an approved mitigation bank or in-lieu fee program, it should include the number and resource type of credits to be secured and how these were determined.

6. Mitigation work plan. Detailed written specifications and work descriptions for the mitigation project, including: the geographic boundaries of the project; construction methods, timing, and sequence; source(s) of water; methods for establishing the desired plant community; plans to control invasive plant species; proposed grading plan; soil management; and erosion control measures. For stream mitigation projects, the mitigation work plan may also include other relevant information, such as planform geometry, channel form (e.g., typical

channel cross-sections), watershed size, design discharge, and riparian area plantings.

7. Maintenance plan. A description and schedule of maintenance requirements to ensure the continued viability of the resource once initial construction is completed.

8. Performance standards. Ecologically-based standards that will be used to determine whether the mitigation project is achieving its objectives.

9. Monitoring requirements. A description of parameters monitored to determine whether the mitigation project is on track to meet performance standards and if adaptive management is needed. A schedule for monitoring and reporting monitoring results to the DE must be included.

10. Long-term management plan. A description of how the mitigation project will be managed after performance standards have been achieved to ensure the long-term sustainability of the resource, including long-term financing mechanisms and the party responsible for long-term management.

11. Adaptive management plan. A management strategy to address unforeseen changes in site conditions or other components of the mitigation project, including the party or parties responsible for implementing adaptive management measures.

12. Financial assurances. The DE may require additional information as necessary to determine the appropriateness, feasibility, and practicability of the mitigation project.

Other information. The DE may require additional information as necessary to determine the appropriateness, feasibility, and practicability of the mitigation project.

Appendix C

CLEAN WATER ACT SECTION 404(b)(1) ASSESSMENT

SECTION 404(b)(1) EVALUATION

Mississippi River and Tributaries
Morganza to the Gulf of Mexico, Louisiana Project

Terrebonne Parish, Louisiana

Revised Programmatic Environmental Impact Statement

I. Project Description

a. Location. The project is located approximately 60 miles southwest of New Orleans, Louisiana, and includes most of Terrebonne Parish, excluding the barrier islands, and the portion of Lafourche Parish between the Terrebonne Parish eastern boundary and Bayou Lafourche (Figure 1). The study area extends south to the saline marshes bordering the Gulf of Mexico and encompasses approximately 1,900 square miles. The 404(b)(1) short form prepared for the previously constructed first lift of J1 and the Revised Draft Programmatic Environmental Impact Statement prepared for this project are here in incorporated by reference.

b. General Description. 1% Annual Exceedance Probability Storm Surge Risk Reduction System (1% AEP Alternative) provides risk reduction for water levels that have a 1% chance of occurring each year (see figure). This alternative includes programmatic elements that would be further investigated in the future and constructible elements for which this consistency determination would serve as the required documentation for the Coastal Zone Management Act. The features that have been to be identified as constructible include, the first lift of Levee Reach F1 and F2, Levee Reach G1, Houma Navigation Canal Lock Complex (HNC Lock), and Bayou Grand Caillou Floodgate (BGC floodgate).

The 98-mile levee system would extend from high ground along US 90 near the town of Gibson and tie into Hwy 1 near Lockport, LA in Lafourche Parish. Planned levee elevations range from 15.0 to 26.5 feet NAVD88. Toe-to-toe levee widths range from 282 feet to 725 feet. It will take several levee lifts to reach these dimensions. Twenty-two navigable floodgate structures, ranging in elevation from 17.0 to 33 feet (NAVD88), would be located on waterways throughout the levee system, including a lock complex on the HNC. Additionally, environmental water control structures would allow tidal exchange at 23 locations through the levee through sluice gates and box culverts.

Nine road gates would be located at the following levee/road crossings: NAFTA, Four Pointe Road, Highway 315 (DuLarge), Highway 55, Highway 56, Highway 24, Highway 3235, Union Pacific RR, and Highway 665. Fronting protection would be provided for four pumping stations, including the Madison, Pointe aux Chenes, Elliot Jones (Bayou Black), and Hanson Canal pump stations.

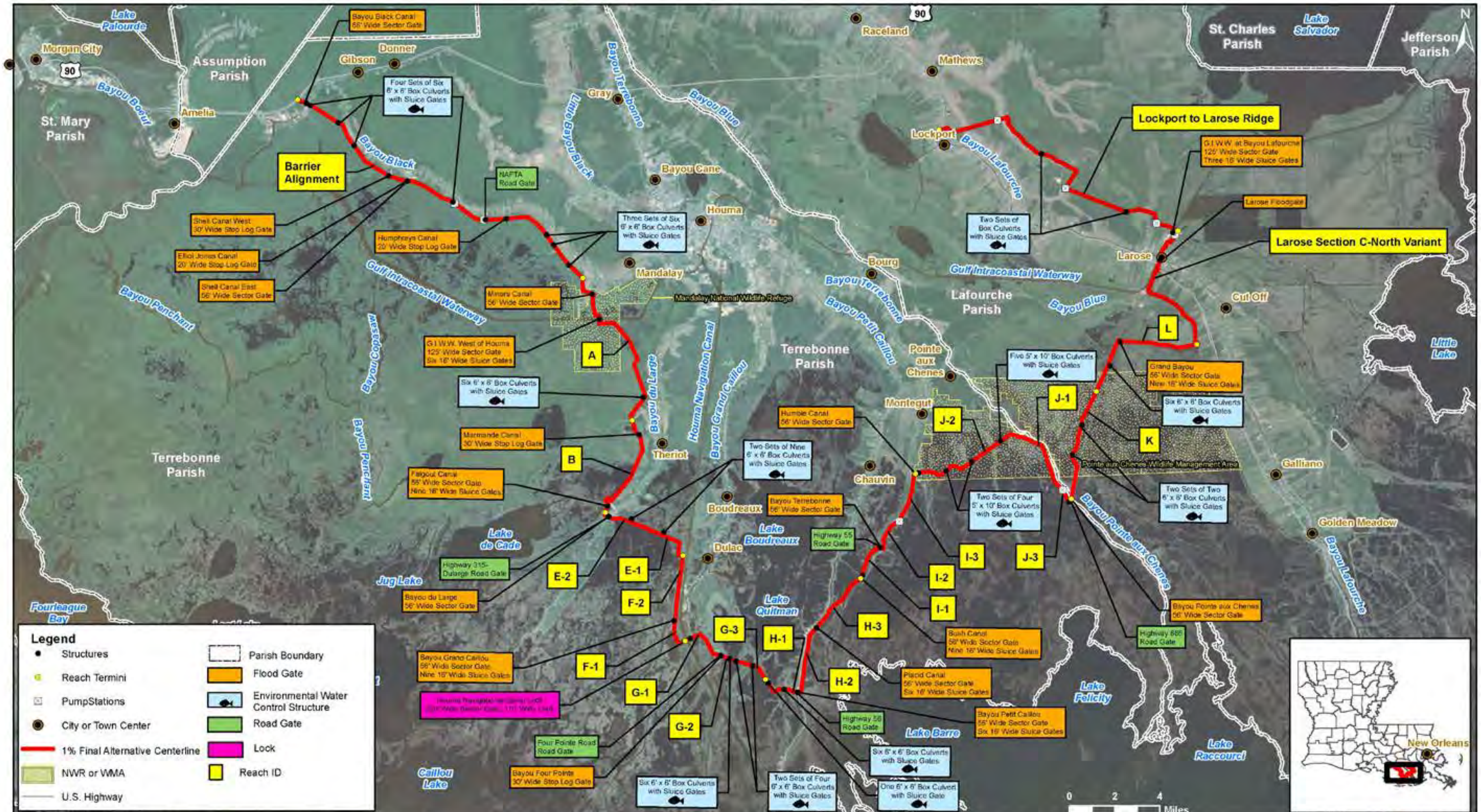


Figure 1. ALIGNMENT AND STRUCTURES OF THE 1% ANNUAL EXCEEDANCE PROBABILITY STORM SURGE RISK REDUCTION SYSTEM ALTERNATIVE

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

Image: I3 USA Prime Imagery

Figure: 1
Date: June 2012
Scale: 1:256,000
Source: USACE/GEC
Map ID: 273160010-2811

Levees would be constructed using a combination of side-cast and hauled-in borrow materials. Adjacent sidecast was planned for the pre-load section only. Borrow pits are oversized to offset the potential for encountering organics, expected losses, etc. Structures on Federally maintained navigation channels include the Houma Navigation Canal Lock Complex (and 250-ft sector gate) and two 125-ft sector gates on the GIWW east and west of Houma. In addition, thirteen 56-ft sector gates and five 20- to 30-ft stop log gates are located on various waterways that cross the levee system.

The constructible features would directly impact intermediate and brackish marsh, while the programmatic features have the potential to directly impact bottomland hardwoods, swamp, fresh, intermediate, brackish, and saline marsh. Approximately 126 million cubic yards of earthen material (quality based Hurricane Storm Damage Risk Reduction System (HSDRRS) Guidelines) would be used to build the complete levee alignment to its full height.

The proposed action itself consists of measures to minimize the adverse effects of storm water erosion and thus requires no separate measures or controls for compliance with Clean Water Act Section 402(p) and LAC 33:IX.2341.B.14.j.

c. <u>Authority and Purpose</u>. The study is authorized by: House Resolution, Docket 2376, April 30, 1992; and WRDA 96 (PL 104-303, Sec 425) the Energy and Water Development Appropriation Act of 1995 (PL 103-316), Section 425 of WRDA 96 (PL 104-303), Section 158 of the Energy and Water Development Appropriations Act, 2004 (PL 108-137), and Section 1001 of WRDA 2007 (Public Law 110-114) authorized construction for the project for:

> *hurricane and storm damage reduction, Morganza to the Gulf of Mexico, Louisiana: Reports of the Chief of Engineers dated August 23, 2002, and July 22, 2003, at a total cost of $886,700,000, with an estimated Federal cost of $576,355,000 and an estimated non-Federal cost of $310,345,000. The operation, maintenance, repair, rehabilitation, and replacement of the Houma Navigation Canal lock complex and the Gulf Intracoastal Waterway floodgate features of the project described in subparagraph (A) that provide for inland waterway transportation shall be a Federal responsibility in accordance with section 102 of the Water Resources Development Act of 1986 (33 U.S.C. 2212).*

The Post Authorization Change (PAC) report and Revised Programmatic Environmental Impact Statement (RPDEIS) have been prepared and are incorporated by reference here in.

The purpose of this project is to provide flood risk reduction for the communities located within the levee system. The goal is to maximize the number of residential and commercial structures protected from damage caused by hurricane storm surges. The project is needed because of the increasing susceptibility of coastal communities to storm surge due to wetland loss, sea level rise, and subsidence. Hurricanes and tropical storm tidal surges have caused immense property damage, human suffering, destruction of natural habitat, and loss of human life in the two-parish study area. While the Terrebonne Levee and Conservation District is currently maintaining a system of forced drainage levees, pump stations, and flood control structures for Terrebonne Parish, adequate hurricane and storm risk reduction is not currently available for the entire area. This project represents an opportunity to reduce the risk of catastrophic hurricane and tropical storm damages by implementing an effective, comprehensive system for hurricane and flood risk reduction.

d. General Description of Dredged or Fill Material

(1) General Characteristics of Material. Material used for embankment will be levee grade material meeting HSDRRS Guidelines. Levee grade material is currently defined and specified as follows: Earth materials naturally occurring or Contractor blended materials that are classified in accordance with ASTM D2487 as CL or CH with less than 35% sand content are suitable for use as embankment fill (Materials classified as ML are suitable if blended to produce a material that classifies as CH or CL according to ASTM D 2487). Materials shall be free from masses of organic matter, sticks, branches, roots, and other debris including hazardous and regulated solid wastes. Isolated pieces of wood will not be considered objectionable in the embankment provided their length does not exceed 1 foot, their cross-sectional area is less than 4 square inches, and they are distributed throughout the fill. Not more than 1 percent (by volume) of objectionable material shall be contained in the earth material placed in each cubic yard of the levee section. Pockets and/or zones of wood shall not be placed in the embankment. Materials placed in the section must be at or above the Plasticity Index of 10. Materials placed in the section must be at or below organic content of 9 percent by weight, as determined by ASTM D 2974, Method C. All other material from the adjacent borrow sites will be used for the marsh mitigation sites.

(2) Quantity of Material. Approximately 126 million cubic yards of earthen material (quality based on post-Katrina standards) would be used to build the complete levee alignment to its full height. It is estimated that approximately 6,090,000 cubic yards of material will be placed for the constructible features.

(3) Source of Material. Levees would be constructed using a combination of sidecast and hauled-in borrow materials. Adjacent sidecast was planned for the pre-load section only. Borrow pits are oversized to offset the potential for encountering organics, expected losses, etc. For the constructible features dredged material (spoil) would come from the bypass channel and HNC lock area and adjacent borrow pits flood side levee reaches F1 and F2 and the protected side of levee reach G1. Approximately the top 5 feet of organic material unsuitable for levees would be used for the construct of marsh for mitigation. Offsite borrow locations would not be located in wetland areas and would be covered in future 404(b)(1) evaluations for the programmatic features.

e. Description of the Proposed Discharge Site(s)

(1) Location. See figure 1 and see map book connected to the RPDEIS.

(2) Size. Approximately 6,682 acres will have dredged material placed to create the levees (approximately 528 acres in BLH, 600 acres in swamp, 2,985 in marsh, 3,270 in natural water, and 528 in canals) for all features of the project. Fill would be placed in approximately 721 acres of marsh, 134 acres of natural water and 267 acres of canals for the

constructible features. The mitigation marsh creation sites for the programmatic features have not been identified. Dredged material will be place in approximately 916 acres of primarily open water to create the marsh mitigation sites.

(3) Type of Site. Dikes would be used at each marsh mitigation site to contain placed earthen materials until the materials have consolidated and wetland vegetation has become established. Dikes would also be used to contain the material to build the levees.

(4) Type(s) of Habitat. The constructible features would directly impact intermediate and brackish marsh, while the programmatic features have the potential to directly impact bottomland hardwoods, swamp, fresh, intermediate, brackish and saline marsh.

(5) Timing and Duration of Discharge.

Implementation Schedule	
Activities	**Years for 1% AEP**
Real Estate Acquisition, Utility Relocations, and Mitigation	2014 to 2025
Construction of Structures	2015 to 2024
Construction of Levee Lifts to Achieve Base Year Elevations	2015 to 2035
Construction of Levee Lifts to Achieve Future Year Elevations	2035 to 2071

f. Description of Disposal Method. A bucket dredge will be used for excavation of adjacent borrow, but various other dredge types could be used as well.

II. Factual Determinations

a. Physical Substrate Determinations

(1) Substrate Elevation and Slope

Programmatic Features
The project footprint consists of emergent and forested wetlands, distributary ridges, and natural and manmade water bodies with associated levees/spoil banks. Construction of the proposed project features would convert habitat within the project footprint to either upland terrain or wetland habitat (with the exception of areas where habitat type will not change). In total, the project would directly impact 3,286 acres of open water habitat, 4,364acres of wetland habitat, and 6,336 acres of upland habitat.

Levee Reaches: As several thousand acres within the footprint of the proposed levee alignment consist of open water or wetland habitat, placement of dredged or fill material for levee construction would convert these areas to upland habitat. **Table 1** depicts final pre-settlement levee dimensions for the proposed project. Levees would be constructed in a total of four lifts for all reaches except for reach G, which will be constructed in three lifts. Variable and sometimes large time intervals (4-35 years) would separate lift cycles. Further levee lift schedule information is available in the *Morganza to the Gulf of Mexico, Louisiana Draft PAC Draft Engineering Appendix*.

Table 1 – Proposed pre-settlement levee dimensions by reach*

Reach	Reach Length (Miles)	Crown Elevation (ft NAVD88)	Base Elevation (ft NAVD88)	Crown Width (ft)	Levee Width (Not Including Berm) (ft)	Total Levee Width (ft)	Levee Side Slope (Protected Side)	Levee Side Slope (Flood Side)	Berm Side Slopes (Protected Side)	Berm Side Slopes (Flood Side)
A/Barrier Alignment	15.7/8.18	22	-1	10	82	329	1V:4H	1V:4H	1V:10H; 1V:3H at Toe	1V:15H; 1V:6H at Toe
B	5.07	20.5	-2	10	64	520	1V:4H	1V:4H	1V:26H; 1V:4H at Toe	1V:15H; 1V:30H; 1V:5H at Toe
E	4.66	25	-1	10	88	725	1V:4H	1V:4H	1V:29H; 1V:3H at Toe	1V:15H; 1V:25H; 1V:5H at Toe
F	4.04	25	0.5	10	89	480	1V:4H	1V:4H	1V:20H; 1V:4H at Toe	1V:13H; 1V:6H at Toe
G	5.72	26	-1	10	95	550	1V:4H	1V:4H	1V:19H; 1V:6H at Toe	1V:19H; 1V:6H at Toe
H1	1.95	25.5	-1	10	96	435	1V:4H	1V:4H	1V:17.5H; 1V:6H at Toe	1V:15H; 1V:6H at Toe
H2/H3	2.58/3.43	28	-2	10	104	500	1V:4H	1V:4H	1V:23H; 1V:6H at Toe	1V:15H; 1V:6H at Toe
I	5.70	28	-1	10	110	425	1V:4H	1V:4H	1V:24H; 1V:4H at Toe	1V:15H; 1V:4H at Toe
J1/J2	3.14/4.89	28	-1	10	101	654	1V:4H	1V:4H	1V:21H; 1V:4H at Toe	1V:15H; 1V:6H at Toe
J3	1.31	28	-1	10	90	740	1V:4H	1V:6H	1V:20H; 1V:5H at Toe	1V:20H; 1V:4H at Toe
K/L	5.04/5.90	26	0	10	94	644	1V:4H	1V:4H	1V:21H; 1V:11H at Toe	1V:25H; 1V:10H at Toe

* Dimensions of the Larose to Lockport Ridge and Larose Section C-North Variant levees will be determined in later phases of the project and included in a separate 404(b)(1) assessment.

Mitigation Sites: Approximately 4,364acres of wetlands, including marsh, swamp, and bottomland hardwood habitats, are to be constructed for mitigation associated with direct loss of wetland habitat from levee construction. A portion of this mitigation would consist of construction of 1,175 acres of marsh habitat using the top 5 ft of borrow material from adjacent borrow areas associated with initial levee lifts.

In accordance with CWPPRA program marsh creation assumptions, dredged material would be mechanically placed in confined marsh creation sites to an initial construction elevation of +2.5 ft NAVD88, and would be expected to settle to elevations ranging between the initial construction elevation and +1.37 ft NAVD88 after initial placement. Confinement dikes would be constructed to +3.0 ft NAVD88. Typical side slopes for confinement dikes used for marsh creation are 1V:3H. In general, mitigation sites associated with adjacent levee borrow areas would be constructed on the flood side of the proposed alignment; while a majority of these sites appear to be predominantly sites where historical marsh loss has occurred, some sites include existing marsh as well as natural bayous. In many cases, mitigation sites associated with adjacent levee borrow areas are situated directly adjacent to these borrow areas. Details regarding mitigation site locations and footprints are available in the *Morganza to the Gulf of Mexico, Louisiana Revised Programmatic Environmental Impact Statement*.

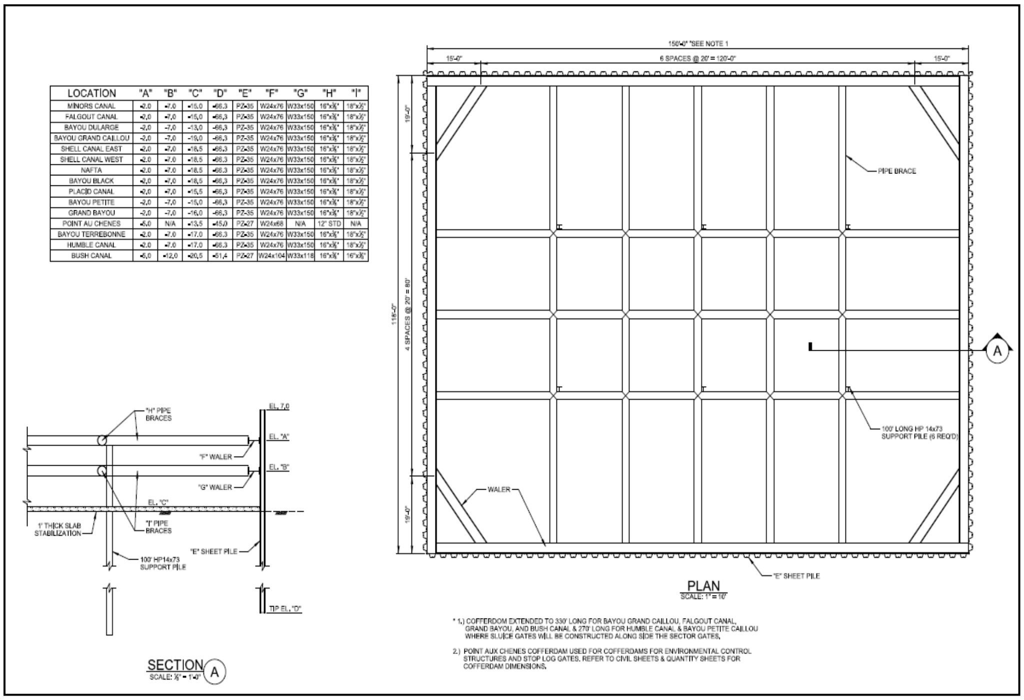
Structures: The proposed project includes a navigation lock, twenty two (22) navigable floodgates, twenty three (23) environmental control structures, nine (9) road gates, and fronting protection for four (4) existing pump stations. **Table 2** identifies the various floodgates included in the proposed project. Cofferdams would be utilized to construct floodgates in the dry; conceptual cofferdam dimension have been established for most floodgates included in the proposed project (**Figure 1**). More information concerning floodgates and floodgate construction can be found in the *Morganza to the Gulf of Mexico, Louisiana Draft PAC Draft Engineering Appendix*.

Table 2 – Navigable floodgates included in the proposed project*

Reach	Waterway	Structure Design Size/Type	Design Elevation (ft NAVD88)
Barrier	Bayou Black	56-ft sector gate	22
	Shell Canal West	30-ft stop log gate	23.5
	Shell Canal East	56-ft sector gate	23.5
	Elliot Jones Canal	20-ft stop-log gate	23.5
	Humphreys Canal	20-ft stop-log gate	23.5
A (north of GIWW)	Minor's Canal	56-ft sector gate	23
A	GIWW West (at Houma)	125-ft sector gate	23
B	Marmande Canal	30-ft stop-log gate	23
	Falgout Canal	56-ft sector gate	23
E-2	Bayou Du Large	56-ft sector gate	25.5
F-1	Bayou Grand Caillou	56-ft sector gate	25.5
G-1	HNC	250-ft sector gate and lock	30.5
G-2	Four Point Bayou	30-ft stop-log gate	30
H-1	Bayou Petit Caillou	56-ft sector gate	30.5
H-2	Placid Canal	56-ft sector gate	31.5
H-3	Bush Canal	56-ft sector gate	33
I-1	Bayou Terrebonne	56-ft sector gate	33
I-3	Humble Canal	56-ft sector gate	33
J-3	Bayou Pointe aux Chenes	56-ft sector gate	33
L	Grand Bayou	56-ft sector gate	29.5
L*	GIWW East (at Larose)	125-ft sector gate	21.5

* Dimensions of the Larose to Lockport Ridge and Larose Section C-North Variant structures will be determined in later phases of the project and included in a separate 404(b)(1) assessment.

Figure 1 – Proposed cofferdam dimensions for select floodgates



Construction of floodgates will also include excavation of material for structural excavation and bypass channel construction. Up to 200,000 cubic yards of material will be excavated for each structure. At this time, disposal of this material has not been resolved.

Environmental control structures consist of box culverts and sluice gates allowing tidal exchange. Culvert dimensions are either 6 ft x 6 ft or 5 ft x 10 ft. Between one (1) and nine (9) box culverts would be included at each environmental control structure. Construction of environmental control structures will also include excavation of material for structural purposes. Up to 18,000 cubic yards of material will be excavated for each structure. At this time, disposal of this material has not been resolved.

Six (6) roadway gates would be constructed along the alignment at LA Highway 182 (Bayou Black Drive), LA Highway 315 (Bayou Du Large Road), Four Point Road, LA Highway 56, LA Highway 55, LA Highway 665 (Point Aux Chenes Road), and a private road on NAFTA property. All roadways would have a swing gate, except LA 182 which would have a ramp. For LA 182, alternate access for locals will need to be made available during the construction of the earthen ramp, which will need to be raised each time the levee is raised. The features associated with construction of each roadway gate structure are a steel swing gate, concrete monolith, and traffic control devices.

Fronting protection is provided for eight (8) pumping stations, including the Madison, Pointe aux Chenes, Elliot Jones (Bayou Black), and Hanson Canal pump stations. Features associated with the construction of fronting protection include T-walls and butterfly gate valves as shown in figure 5-4. All fronting protections would be constructed on the flood side of the existing protection. Based on site visits, the discharge pipes extend far enough that additional pipes are not needed. Butterfly valves would be opened to allow pumping discharge for interior drainage or closed to prevent backflow during storm conditions. Construction of fronting protection will also include excavation of material for structural purposes. Up to 21,000 cubic yards of material will be excavated for fronting protection associated with each pump station. At this time, disposal of this material has not been resolved.

Constructible Features

Levee Reaches (F and G-1): See discussion of programmatic features for levee dimensions for reaches F and G-1. For these reaches, conventional, land-based construction would be utilized. Therefore, there will be no placement of dredged or fill material within surface waters for construction of these levee reaches apart from actual levee construction.

Houma Lock Complex: The largest structure in the Morganza to the Gulf project is the HNC lock complex, which consists of a 110-ft wide by 800-ft long lock with an adjacent 250-ft wide floodgate. The lock complex has a +30.5 ft NAVD88 top elevation and a -18.0 ft NAVD88 sill elevation.

Figure 2 is a conceptual drawing of the HNC lock complex. Features shown in the figure appear in bold in the following text:

• The HNC lock complex is generally oriented in a north-south direction approximately 3,000 ft south of the intersection of the HNC with Bayou Grand Caillou and is located in a bypass channel adjacent to the HNC on its west side.
• The lock structure consists of two lock gate monoliths (gulf side lock gates and inland lock gates), which house two sets of sector gates, and five U-frame lock chamber monoliths. A floodgate monolith adjoins the gulf side lock gate monolith and houses a sector gate, which is separated from the gulf side lock gates to the west by 59 ft. The five lock monoliths and the floodgate monolith are made of cast-in-place, reinforced concrete, and are pile supported.
• T-walls extend from both sides of the lock and floodgate to tie into the proposed Morganza to the Gulf hurricane system at levee reach F-1 to the west and levee reach G-1 to the east, transitioning to levee elevations +23.5 and +24 ft NAVD88 (in year 2085), respectively. Within the T-walls, there are a total of ten 5-ft wide by 10-ft high sluice gates—four between the floodgate and Levee Reach F-1, two between the lock and floodgate, and four between the lock chamber and closure dam.
• A closure dam closes the existing HNC channel near the confluence of Bayou Platte and the HNC. The dam is underlain by a grid of soil-cement columns installed with the dry method of deep-soil mixing. The closure dam is a rock dam constructed to elevation +8.0 ft NAVD88 with a T-wall on top that provides protection to elevation +30.5 ft NAVD88.

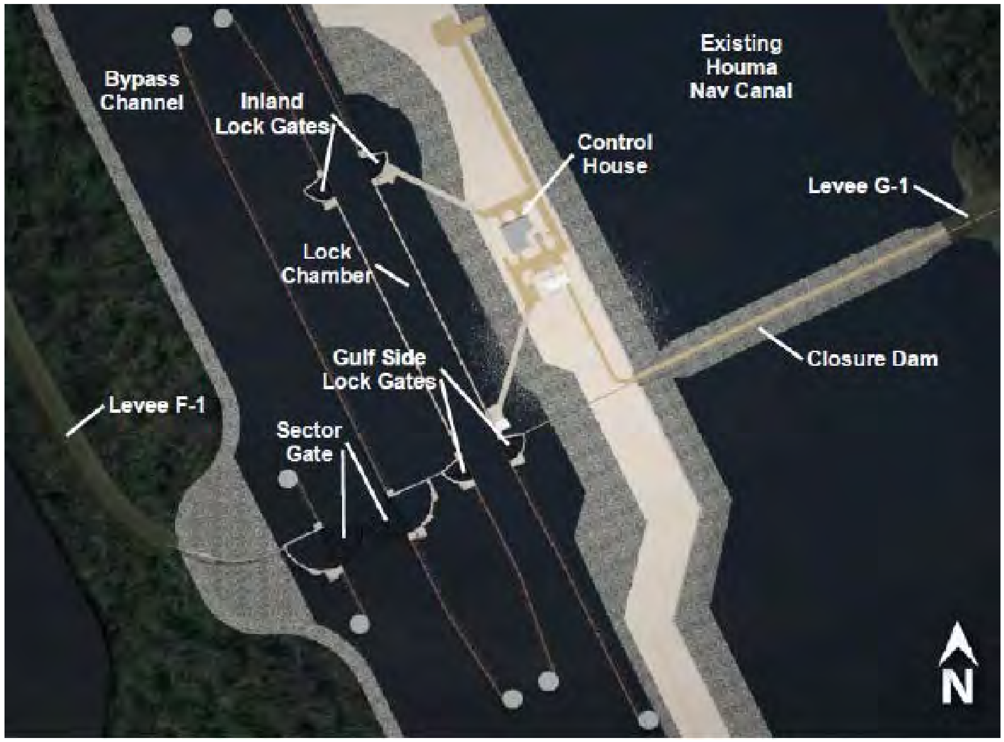


Figure 2 -Conceptual Drawing of the HNC Lock Complex

As with other navigable floodgate structures included in the project, a cofferdam would be constructed to allow for lock construction in the dry.

Bayou Grand Calliou Floodgate: The Bayou Grand Calliou Floodgate is a 56-ft sector gate. This sector gate would be constructed to elevation +25.5 ft NAVD88. As mentioned in discussion of programmatic features, a cofferdam would be constructed for this feature to allow for construction in the dry (**Figure 1**).

Construction of the Bayou Grand Calliou will also include excavation of material for structural excavation and bypass channel construction. Approximately 35,000 cubic yards of material will be excavated for the floodgate. At this time, disposal of this material has not been resolved.

(2) Sediment Type

Programmatic Features

The surface and shallow subsurface of the project area is generally comprised of natural levee, swamp, and marsh deposits. Natural levee deposits are at the surface and underlie marsh and swamp deposits and occur adjacent to abandoned courses and distributaries. Natural levee deposits generally consist of soft to stiff clays interbedded with layers and lenses of silt and silty sand. Natural levee deposits vary in thickness but generally range from 5 to 20 feet. Swamp and marsh deposits are located adjacent to natural levee deposits and comprise most of the land area in the project area. They consist mainly of very soft to medium, organic clays, with lenses of soft to medium lean clay, peat, silt, and silty sand. Swamp deposits contain wood. These deposits generally range from 5 to 20 feet thick. Interdistributary deposits underlie marsh, swamp, and natural levee deposits and consist of soft to medium clay interbedded with layers and lenses of very soft to medium lean clay, silt, and silty sand and occasional lenses of shell. Interdistributary deposits generally range from 80 to 120 feet thick. Swamp deposits are also frequently interbedded with interdistributary deposits. Intradelta deposits underlie marsh, swamp, and natural levee deposits and are interbedded with interdistributary deposits. Intradelta deposits are associated with delta progradation and are found adjacent to abandoned courses and major distributaries. Intradelta deposits consist of silt, silty sand and sand with occasional layers and lenses of soft to medium, fat and lean clays. Intradelta deposits vary in thickness but average 10 feet thick.

Levee Reaches: Borrow material for the first lift will be obtained from adjacent borrow areas for all levee reaches except **Reach A**. For all other lifts, borrow material will be obtained from approved offsite borrow sources.

Material used for levee construction will be levee grade material meeting HSDRRS Guidelines. Levee grade material is currently defined and specified as follows: Earth materials naturally occurring or Contractor blended materials that are classified in accordance with ASTM D2487 as clay (CL) or high plasticity, fat clay (CH) with less than 35% sand content are suitable for use as embankment fill (Materials classified as silt [ML] are suitable if blended to produce a material that classifies as CH or CL according to ASTM D 2487). Materials shall be free from masses of organic matter, sticks, branches, roots, and other debris including hazardous and regulated solid wastes. Isolated pieces of wood will not be considered objectionable in the embankment provided their length does not exceed 1 foot, their cross-sectional area is less than 4 square inches, and they are distributed throughout the fill. Not more than 1 percent (by volume) of objectionable material shall be contained in the earthen material placed in each cubic yard of the levee section. Pockets and/or zones of wood shall not be placed in the embankment. Materials placed in the section must be at or above the Plasticity Index of 10. Materials placed in the section must be at or below organic content of 9 percent by weight, as determined by ASTM D 2974, Method C.

Soil and geologic profiles conducted along the proposed levee alignment indicate a majority of soils consist of CH and CL, with interspersed lenses of silt and sand. A majority of adjacent borrow material is therefore anticipated to meet HSDRRS guidelines for levee grade material.

Mitigation Sites: The topmost 5 feet of material from borrow areas adjacent to the proposed levee alignment would be used for creation of 1,175 acres of marsh. As material is highly organic, placement of material will result in a layer of highly organic sediments of varying thickness underlain primarily by swamp and marsh deposits consisting of CH and CL.

Structures: Material used in construction of structures would either consist of backfill from adjacent areas or offsite borrow. Adjacent backfill characteristics would be dependent on location and depth; however, as stated earlier, a majority of soils in the project area can be classified as either CH or CL. Offiste borrow material would be required to meet HSDRRS guidelines for levee grade material.

Constructible Features
Levee Reaches (F and G-1): Borrow material for these levee reaches would be derived from HNC lock and bypass channel excavation. The soil and geologic profile conducted nearest to the bypass channel (Reach G-1) indicates a majority of soils within 20 feet of the surface consist of CH and CL, with interspersed lenses of silt and sand. A majority of borrow material associated with HNC lock and bypass channel excavation is therefore expected to meet HSDRRS guidelines for levee grade material.

Houma Lock Complex: Material used in lock construction would either consist of backfill from adjacent areas or offsite borrow. Adjacent backfill characteristics would be dependent on location and depth; however,, a majority of soils in the vicinity of the lock complex can be classified as either CH or CL. Offsite borrow material would be required to meet HSDRRS guidelines for levee grade material.

Bayou Grand Caillou Floodgate: Material used in construction of the Bayou Grand Caillou Floodgate would either consist of backfill from adjacent areas or offsite borrow. Adjacent backfill characteristics would be dependent on location and depth; however,, a majority of soils in the vicinity of the lock complex can be classified as either CH or CL. Offsite borrow material would be required to meet HSDRRS guidelines for levee grade material.

(3) Dredged/Fill Material Movement

(All Features)
Levee Reaches: Material placed for levee construction would be contained within the levee right of way with berms or small dikes. Movement of material beyond the levee right of way is not anticipated.

Mitigation Sites: Because mitigation sites would include confinement dikes, no lateral movement of dredged material is anticipated.

Structures: Structure materials and any associated cofferdams would not be expected to move or shift after final placement.

(4) Physical Effects on Benthos (burial, changes in sediment types, etc)

(All Features)
Sessile aquatic organisms within the footprint of project features would be smothered by dredged and fill materials. For structures and levees, because these sites will be converted to terrestrial habitat, these organisms would not reestablish. For mitigation areas, organisms adapted to survival in marsh vegetation would establish. Following cofferdam removal, aquatic organisms formerly present within the footprint of cofferdams would reestablish in areas within the footprint which still consist of aquatic habitat.

(5) Other Effects

(6) Actions Taken to Minimize Impacts:

(All Features)
Confinement dikes and berms would be used to prevent lateral movement of dredged or fill material during construction activities.

b. Water Circulation, Fluctuation, and Salinity Determinations

(1) Water

(a) Salinity

(All Features)
Prediction of impacts to salinities within the Terrebonne estuary was performed using a TABS-MDS model simulating with- and without-project salinities, water levels, and water velocities; a summary of model results is available in the modeling report *Comparison of Plan Alternatives for the Morganza to the Gulf of Mexico Levee System.* Globally in the project area, salinity changes are expected to be less than 1 part per thousand (ppt) with the largest changes occurring in the areas to the north and south of the HNC Lock when complex when it is closed (Plan 3 in the model report), and south of the Falgout Canal and north of Point Aux Chene when environmental structures are in the open position (Plans 1 and 3 in the model report). The addition of environmental water control structures along Falgout Canal allow new freshwater inflow to the area south of the canal, which in turn reduces the salinity (about 3 ppt on average), with the largest reduction occurring during the winter months and minimal reduction occurring during the summer months. The Falgout Canal and Lake Boudreaux areas would be freshened as the closed HNC structure forces the freshwater flow to divert along other avenues, thereby freshening the surrounding areas. Addition of environmental water control structures near Point aux Chenes appears to introduce higher salinity waters to the area north of the proposed levee alignment irrespective of seasonality. During closure of the HNC Complex, salinity will increase in the area to the south of the Complex, while salinity

intrusion to inland areas via the HNC would be reduced.

With the increase in sea-level rise, it is anticipated that the local sponsor may desire more frequent closure of environmental control structures to reduce damages from higher stages unrelated to storm events. If this change in operation were authorized, changes to salinity in the Terrebonne estuary resulting from the project may be more significant than those predicted through modeling.

Because bypass channels would be constructed prior to construction of cofferdams for navigable floodgates, and therefore impacts to water circulation for adjacent waters during construction would be minimized, no significant impacts to salinity are anticipated as a result of cofferdams.

(b) Water Chemistry (pH, etc.)

Programmatic Features

Dredging and placement may result in short term effects on pH. Factors typically associated with dredging activities may cause pH in receiving area waters to shift toward more acidic conditions. These factors include increased turbidity, organic enrichment, chemical leaching, reduced dissolved oxygen, and elevated carbon dioxide levels, among others.

Ambient pH values in the project area range between 6.27 and 8.7, with an average of 7.6

The proposed project primarily traverses existing hydraulic barriers within the Terrebonne estuary and includes a myriad of water control structures, minimizing impacts to water circulation as practicably as possible while still providing hurricane protection. However, localized changes in water circulation may occur within the project area. These localized changes in water circulation may induce localized changes in pH within the study area.

With the increase in sea-level rise, it is anticipated that the local sponsor may desire more frequent closure of environmental control structures to reduce damages from higher stages unrelated to storm events. If this change in operation were authorized, changes in pH levels within the study area may become significant. For example, more frequent closure of structures could lead to a greater level of influence of Atchafalaya River water north of the proposed levee alignment. Because the river water contains high alkalinity and elevated nutrient levels, pH levels in this area may increase directly or through eutrophication.

Levee Reaches: Material proposed as levee fill would be confined by berms. Therefore, only minimal amounts of fill material (primarily material associated with berm construction) would directly impact adjacent water bodies. Associated impacts to the water column from placement of levee fill material would therefore be localized and temporary.

Mitigation Sites: Effluent discharges from mitigation sites would result in a temporary reduction in pH for adjacent waters. The tidal action in the vicinity of mitigation sites would help to reduce pH effects by dispersing and diluting mitigation site effluent waters. As emergent wetland vegetation establishes at sites, pH levels would return to normal.

Structures: Minor and localized impacts to pH levels in adjacent waters may occur during placement of cofferdam, construction, and backfill materials. These impacts would be expected to last the duration of construction activities.

(c) Clarity

(All Features)
Placement of dredged or and fill material is expected to result in localized turbidity plumes, which would affect water clarity. Following completion of construction activities, the occurrence of these turbidity plumes would no longer occur.

(d) Color

(All Features)
Placement of dredged or and fill material is expected to result in localized turbidity plumes, which would affect water color. Following completion of construction activities, the occurrence of these turbidity plumes would no longer occur.

(e) Odor

(All Features)
Placement of adjacent borrow area sediments will result in the exposure of previously undisturbed, organic and reduced sediments, which is expected to result in an odor which would persist until material is dewatered for levee construction or until emergent wetland vegetation establishes at mitigation sites. No significant odors are anticipated to be associated with offsite borrow material or any other construction materials.

(f) Taste

(All Features)
The nearest potable water intake (via surface water route) to any feature

along the proposed levee alignment is approximately 6 miles. Any possible effects of construction activities for project features would be expected to diminish long before reaching the closest municipal water intake.

(g) Dissolved Gas Levels

(All Features)
Short-term decreases in dissolved oxygen could occur due to introduction of organics from the sediment into the water column, as well as the release of nutrients. Turbidity affects water quality in several ways, one which may markedly affect dissolved oxygen levels. The introduction of nutrients and organic material to the water column as a result of the discharge can lead to a high biochemical oxygen demand (BOD), which in turn can lead to reduced dissolved oxygen, thereby potentially affecting the survival of aquatic organisms. Adjacent borrow area sediment is highly organic, and therefore there is potential for temporarily lowering dissolved oxygen levels at mitigation sites.

Ambient dissolved oxygen values in the project area range between 0.2 and 12.5 mg/L, with an average of 6 mg/L. As discussed in the *Morganza to the Gulf of Mexico, Louisiana Draft PAC Draft Engineering Appendix,* low dissolved oxygen level is the most commonly cited suspected cause of impairment for study area waterbodies. Citation of dissolved oxygen as a suspected cause of impairment occurred disproportionately on the protected side of the proposed levee alignment. The proposed project primarily traverses existing hydraulic barriers within the Terrebonne estuary and includes a myriad of water control structures, minimizing impacts to water circulation as practicably as possible while still providing hurricane protection. However, localized changes in water circulation may occur within the project area. These localized changes in water circulation may induce localized changes in dissolved oxygen levels within the study area.

In addition, with the increase in sea-level rise, it is anticipated that the local sponsor may desire more frequent closure of environmental control structures to reduce damages from higher stages unrelated to storm events. If this change in operation were authorized, changes to dissolved oxygen levels within the study area may be more significant. For example, more frequent closure of structures could lead to the stagnation of low dissolved oxygen waters present to the north of the proposed alignment.

Levee Reaches: Material proposed as levee fill would be confined by berms. Therefore, only minimal amounts of fill material (primarily material associated with berm construction) would directly impact adjacent waterbodies. Associated impacts to the water column from placement of levee fill material would therefore be localized and temporary.

Mitigation Sites: Because of the high organic carbon content of sediment from the borrow areas, the discharge of dredged material for marsh creation at mitigation sites may have a short-term impact on dissolved oxygen levels for effluent waters discharging from the confines of sites. In addition, there is a possibility that dissolved oxygen effects related to the release of ammonia from borrow area sediment pore water could occur. Because mitigation sites are highly tidally influences, it is anticipated that effluent waters would be quickly dispersed and diluted.

Structures: Minor, localized impacts to dissolved oxygen levels in adjacent waters may occur during placement of cofferdam, construction, and backfill materials. These impacts would be expected to last the duration of construction activities.

(h) Nutrients

(All Features)
As discussed in the *Morganza to the Gulf of Mexico, Louisiana Draft PAC Draft Engineering Appendix,* elevated nutrients are a commonly cited suspected cause of impairment for study area waterbodies. Citation of nutrients, total phosphorus, and nitrate/nitrite as a suspected cause of impairment occurred disproportionately on the protected side of the proposed levee alignment. The proposed project primarily traverses existing hydraulic barriers within the Terrebonne estuary and includes a myriad of water control structures, minimizing impacts to water circulation as practicably as possible while still providing hurricane protection. However, localized changes in water circulation may occur within the project area. These localized changes in water circulation may induce localized changes in the distribution of nutrients within the study area.

With the increase in sea-level rise, it is anticipated that the local sponsor may desire more frequent closure of environmental control structures to reduce damages from higher stages unrelated to storm events. If this change in operation were authorized, changes to nutrient levels within the study area may be more significant. For example, more frequent closure of structures could lead to a greater level of influence of Atchafalaya River water north of the proposed levee alignment while preventing flushing of this same area with estuarine waters. Because the river water contains elevated nutrient (particularly nitrate) levels, nutrient concentrations in this area may increase directly.

Levee Reaches: Material proposed as levee fill would be confined by berms. Therefore, only minimal amounts of fill material (primarily material associated with berm construction) would directly impact adjacent waterbodies. Associated impacts to the water column from placement of levee fill material would therefore be localized and temporary.

In addition, because fill material associated with levee construction is anticipated to be dewatered prior to placement, it would be relatively free of ammonia commonly associated with sediment pore water. Therefore, placement of fill material during structure construction is not anticipated to significantly impact nutrient levels in adjacent waters.

Mitigation Sites: Sediments proposed as borrow material for mitigation sites are expected to contain variable levels of organic material, which may release elevated concentrations of ammonia during construction activities related to marsh restoration and nourishment. Because all mitigation sites are in areas heavily influenced by Gulf of Mexico tides, it is anticipated that nutrient releases occurring during construction would be quickly dispersed and diluted.

Structures: Because fill material associated with construction of structures is anticipated to be dewatered prior to placement, it would therefore be relatively free of ammonia commonly associated with sediment pore water. Therefore, placement of fill material during structure construction is not anticipated to significantly impact nutrient levels in adjacent waters.

(i) Eutrophication

(All Features)
As discussed in the *Morganza to the Gulf of Mexico, Louisiana Draft PAC Draft Engineering Appendix,* elevated nutrients and abundance of non-native aquatic plants (both indicators of potential eutrophication) are a commonly cited suspected cause of impairment for study area waterbodies. Citation of nutrients, total phosphorus, nitrate/nitrite, and non-native aquatic plants as a suspected cause of impairment occurred disproportionately on the protected side of the proposed levee alignment. The proposed project primarily traverses existing hydraulic barriers within the Terrebonne estuary and includes a myriad of water control structures, minimizing impacts to water circulation as practicably as possible while still providing hurricane protection. However, localized changes in water circulation may occur within the project area. These localized changes in water circulation may induce localized changes in the distribution of eutrophic conditions within the study area.

With the increase in sea-level rise, it is anticipated that the local sponsor may desire more frequent closure of environmental control structures to reduce damages from higher stages unrelated to storm events. If this change in operation were authorized, changes to levels of eutrophication within the study area may be more significant. For example, more frequent closure of structures could lead to a greater level of influence of Atchafalaya River water north of the proposed levee alignment while preventing flushing of this same area with estuarine waters. Because the river water contains elevated nutrient (particularly nitrate) levels, nutrient concentrations in this area may increase directly, leading to an increase in the frequency and distribution of eutrophic conditions.

Levee Reaches: Material proposed as levee fill would be confined by berms. Therefore, only minimal amounts of fill material (primarily material associated with berm construction) would directly impact adjacent water bodies. Associated impacts to the water column from placement of levee fill material would therefore be localized and temporary.

Mitigation Sites: Sediments proposed as borrow material for mitigation sites are expected to contain variable levels of organic material, which may release elevated concentrations of ammonia during construction activities related to marsh restoration and nourishment. Because all mitigation sites are in areas heavily influenced by Gulf of Mexico tides, it is anticipated that nutrient releases occurring during construction would be quickly dispersed and diluted, thereby preventing localized algal blooms.

Structures: Because fill material associated with construction of structures is anticipated to be dewatered prior to placement, it would therefore be relatively free of ammonia commonly associated with sediment pore water. Therefore, placement of fill material during structure construction is not anticipated to significantly impact nutrient levels or potential for algal blooms in adjacent waters.

(j) Others as Appropriate

(2) Current Patterns and Circulation

(a) Current Patterns and Flow

(All Features)
Predicted project impacts of the project on flows within the Terrebonne estuary are available in the report the modeling report *Comparison of Plan Alternatives for the Morganza to the Gulf of Mexico Levee System.* Model results generally indicate very little change in water levels in the study area and discharge rates through transects along the proposed levee alignment under any of the structure operational plans modeled, indicating that the project would not induce significant changes on the hydrology of

the estuary.

The authorized alignment builds on existing hydrologic barriers, such as natural ridges, roadbeds, or existing levees that have been built for other purposes such as forced drainage or marsh management. Of the estimated 77 miles of levee originally proposed in the authorized alignment, approximately 16 miles would cross part of the estuaries that are currently open to estuarine exchange. The proposed project includes numerous environmental water control structures to allow hydrologic exchange through the levees. In addition, with the exception of the HNC Lock Complex, the navigation structures are planned to closely maintain the present hydrologic exchange characteristics of the waterways, except during tropical storm closure events. At times, the HNC Lock Complex will be operated to reduce salinity in the HNC. This operation would lower the present hydrologic exchange rate along the HNC.

Although it is anticipated that the proposed project will minimize impacts to water circulation, localized changes in water circulation may occur within the project area as a result of the addition of significant basin hydraulic features. In addition, with the increase in sea-level rise, it is anticipated that the local sponsor may desire more frequent closure of environmental control structures to reduce damages from higher stages unrelated to storm events. If this change in operation were authorized, significant changes in water circulation and hydrology within the study area could occur.

(b) Velocity

(All Features)
See II.b.2(a) (Current Patterns and Flow)

(c) Stratification.

(All Features)
The project is generally not expected to contribute to stratification in the water column. During extended durations of closure of the HNC Lock Complex for salinity control, salinity stratification in the HNC inland of the Lock Complex will be reduced due to the restriction of higher salinity water, which can contribute to stratification, from entering the HNC inland of the Lock Complex. However, since salinity will increase in the area south of the Complex during these times, the potential for salinity stratification in the HNC south of the Lock Complex will increase due to higher salinity and reduced circulation.

Extended durations of closure of the HNC Lock complex may also contribute to temperature and dissolved oxygen stratification, both upstream and downstream of the complex. This phenomena has been observed in the Mississippi River Gulf Outlet (MRGO) channel (a similar long and straight navigation channel connecting the Gulf of Mexico with inland areas) following the construction of the MRGO rock barrier.

Because bypass channels would be constructed prior to construction of cofferdams for navigable floodgates, and therefore impacts to water circulation for adjacent waters during construction would be minimized, no significant stratification is anticipated as a result of the implementation of cofferdams.

(d) Hydrologic Regime.

(All Features)
See II.b.2(a) (Current Patterns and Flow **)**

(3) Normal Water Level Fluctuations/Hydroperiod.

(All Features)
See II.b.2(a) Current Patterns and Flow

(4) Salinity Gradients.

(All Features)
See II.b.1.(a) (Salinity)

(5) Actions That Would Be Taken to Minimize Impacts.

(All Features)
A major component of the proposed project includes the construction of 21 environmental control structures along the proposed levee alignment. The purpose of the environmental control structures is to provide flood control during storm conditions and to match existing drainage patterns during non-storm conditions. Environmental control structures consist of box culverts and sluice gates allowing tidal exchange. The number of 6-ft by 6-ft or 5-ft by 10-ft culverts at each location varies from one to nine.

Levees: Material obtained from adjacent borrow areas for initial levee lifts would be dewatered prior to placement, and material will be placed between levee berms, minimizing water column impacts associated with levee construction.

Mitigation Sites: Use of confinement dikes would allow for clarification of effluent waters prior to discharge into receiving waterbodies, thereby reducing water column impacts associated with elevated turbidity levels such as low dissolved oxygen levels.

Structures: Construction of structures (i.e., floodgates, tidal exchange structures, and the locks) would result in localized increases in turbidity associated with runoff of construction materials. To minimize construction-related impacts, it is anticipated that a Stormwater Pollution Prevention Plan (SWPPP) shall be implemented for construction activities. SWPPPs shall be prepared in accordance with good engineering practices emphasizing storm water Best Management Practices and complying with Best Available Technology Economically Achievable and Best Conventional Pollutant Control Technology. The SWPPP shall identify potential sources of pollution, which may reasonably be expected to affect storm water discharges associated with the construction activity. In addition, the SWPPP shall describe and ensure the implementation of practices which are to be used to reduce pollutants in storm water discharges associated with the construction activity and to assure compliance with the terms and conditions of this permit.

c. <u>Suspended Particulate/Turbidity Determinations</u>

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site

(All Features)
Levee Reaches: Material proposed as levee fill would be confined by berms. Therefore, only minimal amounts of fill material (primarily material associated with berm construction) would directly impact adjacent waterbodies. Associated impacts to the water column from placement of levee fill material would therefore be localized and temporary.

Mitigation Sites: Use of confinement dikes would allow for clarification of effluent waters prior to discharge into receiving waterbodies, and would minimize any suspended particulates and turbidity associated with effluent discharge.

Structures: Minor, localized impacts to turbidity levels and water clarity in adjacent waters may occur during placement of cofferdam, construction, and backfill materials. These impacts would be expected to last the duration of construction activities.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light penetration

(All Features)
See II.c.1 Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site.

(b) Dissolved oxygen

(All Features)
See section II.b.1(g) (Dissolved Gas Levels)

(c) Toxic metals and organics

See section II.d (Contaminant Determinations)

(d) Pathogens

(All Features)
The proposed project primarily traverses existing hydraulic barriers within the Terrebonne estuary and includes a myriad of water control structures, minimizing impacts to water circulation as practicably as possible while still providing hurricane protection. However, localized changes in water circulation may occur within the project area. These localized changes in water circulation may induce localized changes in the distribution of waterbourne pathogens within the study area.

As discussed in the *Morganza to the Gulf of Mexico, Louisiana Draft PAC Draft Engineering Appendix,* elevated fecal coliform densities is the second most commonly cited suspected cause of impairment for study area waterbodies. Citation of elevated fecal coliform densities as a suspected cause of impairment occurred disproportionately on the protected side of the proposed levee alignment. The proposed project primarily traverses existing hydraulic barriers within the Terrebonne estuary and includes a myriad of water control structures, minimizing impacts to water circulation as practicably as possible while still providing hurricane protection. However, localized changes in water circulation may occur within the project area. These localized changes in water circulation may induce localized changes in fecal coliform densities within the study area.

In addition, with the increase in sea-level rise, it is anticipated that the local sponsor may desire more frequent closure of environmental control structures to reduce damages from higher stages unrelated to storm events. If this change in operation were authorized, changes to pathogen concentrations within the study area may be more significant. For example, more frequent closure of structures could prevent flushing of waters containing pathogens with relatively clean Gulf of Mexico waters, resulting in stagnation of waters with elevated pathogen concentrations.

(3) Effects on Biota.

(a) Primary production, photosynthesis. Primary production in the project area is subject to normally turbid conditions due to the high-suspended sediment loads within the water column. During actual construction activities of project features there would be short-term direct impacts to phytoplankton populations due to increases in turbidity, low dissolved oxygen (DO), and introduction of dredged sediments into shallow open water areas. Submerged aquatic vegetation (SAV) would be buried at both the marsh creation sites and the levee sites. Photosynthesis rates in the area would drop due to the turbidity and the burial. Phytoplankton populations should return after construction. Photosynthesis rates would return once the turbidity clears and the newly created marsh will replace the loss due to the burial of the SAV.

(b) Suspension/filter feeders. Direct impact will be experienced by filter feeders at the dredging operation and at the disposal sites. Filter feeders will be removed from the dredging locations during dredging operations. Existing filter feeders will be buried at the disposal sites where wetlands and levees are to be created. With favorable conditions, filter feeders will quickly reestablish in the new environments. Filter feeders adjacent to the dredging and placement areas will be indirectly impacted by the increased turbidity. Filter feeders gills can be clogged and prevent feeding. In response the organism will stop feeding and as long as the event is short lived a high mortality rate is not expected.

(c) Sight feeders. Sight feeders in the project area include freshwater and saltwater fish species. Slight visibility decreases will be experienced in the immediate vicinity of the dredging operations. Conditions will return to pre-project levels upon completion of operations. Disposal sites will have material placement to create wetlands eliminating site feeding opportunities but increasing nursery grounds for such species. Levee sites will be removed completely from the use of the fish. A temporary avoidance of the work area will occur.

(4) Actions Taken To Minimize Impacts. Construction operations are expected to temporarily increase the concentration of suspended particulates. Particulates suspended during project construction would dissipate after construction activities are complete. Temporary increases in suspended particulates will be minimized as much as possible through best management practices such as creating containment berms, use of silt fencing, silt curtains, and seeding, to prevent the unnecessary transport of sediments within the construction and placement areas.

d. <u>Contaminant Determinations.</u>

(All Features)
Project-specific sediment, water, and elutriate chemistry data was collected. Water and sediment samples were collected from a total of twelve (12) sites between January 31st and February 2nd, 2011 (see **Table 3 and Figure 3**).

Table 3 – Project-specific water and sediment sampling sites

Station ID	Latitude	Longitude	Station Description	Sampling Date
Site 1	29.650000	-90.872500	Munson's World Famous Swamp Tours, north of Barrier Alignment	1/31/2011
Site 2	29.548056	-90.791111	Near canal with bridge crossing, 1/2 miles east of Minors Canal	1/31/2011
Site 3	29.417500	-90.784722	Canal by upper Bayou du Large pump station	1/31/2011
Site 4	29.335556	-90.843333	Floodgate near end of Bayou Dularge Road	2/1/2011
Site 5	29.389739	-90.733056	South of east end of Falgout Canal	2/1/2011
Site 6	29.384444	-90.729167	Houma Navigation Canal and Falgout Road	2/1/2011
Site 7	29.302222	-90.670000	Highway 57 northwest of Rabbit Bayou – location of proposed culvert with sluice gates	2/1/2011
Site 8	29.387500	-90.587778	Flood side of Mason Canal Road at proposed Bayou Terrebonne floodgate	2/1/2011
Site 9	29.437836	-90.565075	Near dock at Humble Canal, west of Humble Canal floodgate	2/1/2011
Site 10	29.430833	-90.587778	Pump station, Oak Point Road off of Highway 65	2/2/2011
Site 11	29.474122	-90.435028	Shoreline of Grand Bayou Canal at proposed Grand Bayou floodgate	2/2/2011
Site 12	29.543889	-90.402778	Off Highway 24 across from shipyard in GIWW, at proposed Grand Bayou floodgate	2/2/2011

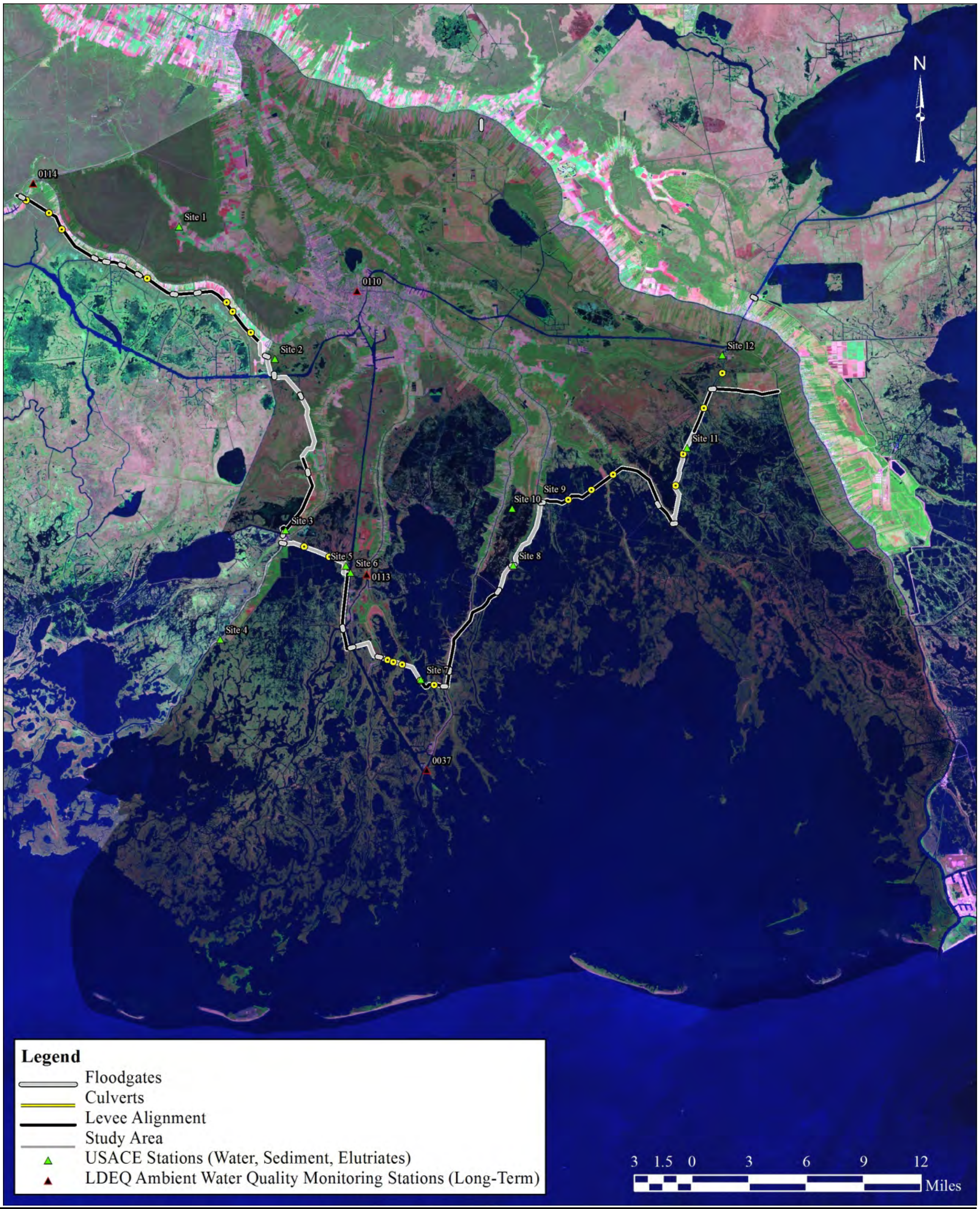


Figure 3 – Project-specific water and sediment sampling sites and LDEQ long-term monitoring stations

The purpose of data collection was to ensure proposed dredged material disposal activities associated with adjacent borrow areas do not have adverse environmental effects on the receiving aquatic environment. Disposal of dredged material should not exceed State or Federal water quality criteria outside of the established mixing zone in order to comply with the section 404(b)(1) guidelines and in order to ensure 401 water quality certification. Evaluation of sediment chemistry was performed to determine whether sediment has the potential to result in mortality of mobile benthic organisms. Evaluation of water and elutriate chemistry is typically performed to determine whether the proposed discharge of dredged material effluent exceeds State and/or Federal water quality criteria outside of the State-enforced mixing zone, and therefore may result in toxicity to water column organisms. Sample preparation and testing is performed in accordance with the *Inland Testing Manual* and/or *Upland Testing Manual*, depending on the proposed dredged material disposal method.

Table 4 displays the chemical classes included in the analysis of sediment, water, and elutriates, the latter of which is a mixture of dredging site water and sediment at proportions intended to replicate those of hydraulic dredging. Up to five (5) herbicides, Fourteen (14) inorganic/general chemistry parameters, twenty one (21) metals, twenty four (24) pesticides, seven (7) PCB congeners, nine (9) PAHs, fifty eight (58) semi-volatile organic compounds, fifty four (54) volatile organic compounds, and total petroleum hydrocarbons were included in the analyses. As a disclaimer, analysis of elutriates for project-specific sampling and analysis does not suggest adjacent borrow would be hydraulically placed for levee construction; in contrast, material would be mechanically excavated and dewatered prior to placement. Therefore, elutriate test results have little bearing on predicted water column impacts during placement of adjacent borrow for levee fill. In addition, the type of elutriate test conducted (modified elutriate or standard elutriate) was not specified in the laboratory report. In summary, the purpose and type of elutriate testing conducted for this project was not specified, however results of testing is being provided herein.

Table 4 – Chemical classes included in sediment, water, and elutriate analysis

Chemical Class	Sediment	Water	Elutriate
Herbicides	X	X	X
Inorganic/General Chemistry	X	X	X
Metals	X	X	X
Pesticides	X	X	X
Polychlorinated Biphenyls	X	X	X
Polycyclic Aromatic Hydrocarbons	X	X	X
Semi-Volatile Organic Compounds	X	X	X
Total Petroleum Hydrocarbons	X	X	X
Volatile Organic Compounds	X	X	

Water and Elutriate Quality

Water and elutriate chemistry data was compared with applicable State and Federal water quality criteria to determine whether results exceeded these criteria. Salinity data from LDEQ water quality monitoring stations in proximity to project-specific sampling sites was used to estimate the salinity regime of these sites, in order to determine applicable water quality criteria (LDEQ water quality criteria exists for freshwater, brackish, and marine waters, while EPA water quality criteria exists for freshwater and marine waters).

Tables 5-6 below display exceedances of water quality criteria for water and elutriates. In most cases, values exceeding criteria are not measured values, but are instead estimates, as results were below the laboratory reporting limit (in other words, the concentration was below that which the laboratory could quantify with confidence).

For freshwater sites (**Tables 5 and 6**), the only exceedances for measured values are for copper (Site 1 elutriate), iron (Site 1 elutriate, Site 2 water, Site 12 elutriate and water), lead (Site 1 elutriate, site 12 elutriate), and mercury (site 1 elutriate). These measured elutriate concentrations, which are for exceedances of chronic water quality criteria, are within one order of magnitude of criteria.

Results below the laboratory reporting limit, when estimated as one-half of the laboratory reporting limit, exceeded acute criteria for cadmium, p,p'-DDD, and toxaphene, for all freshwater sites and both analytical media (water and elutriates), and chronic criteria for cadmium, mercury, p,p'-DDD, p,p'-DDT, endrin, heptachlor, heptachlor epoxide, methoxyclor, toxaphene, and hexachlorobutadiene for all freshwater sites and both analytical media.

Table 5 – Exceedances of water quality criteria for freshwater sites (excludes State hardness-dependent metals criteria)

			Freshwater						Water Quality Criteria			
			Site 1		Site 2		Site 12		LDEQ Freshwater		EPA Freshwater	
Chemical Class	Parameter	Units	Elutriate	Water	Elutriate	Water	Elutriate	Water	Acute	Chronic	Acute	Chronic
Metals	Cadmium	µg/L	2.50	2.50	2.50	2.50	2.50	2.50	b		2	0.25
	Copper	µg/L	17.0	5.00	5.00	5.00	5.00	5.00	b			9
	Iron	µg/L	1,700	930	220	1,100	4,000	2,800				1,000
	Lead	µg/L	14.0	1.50	1.50	1.50	4.80	1.50	b		65	2.5
	Mercury	µg/L	0.220	0.100	0.100	0.100	0.100	0.100	2.04	0.012	1.4	0.77
Pesticides	DDD, p,p'-	µg/L	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.03	0.006		
	DDT, p,p'-	µg/L	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	1.1	0.001	1.1	0.001
	Endrin	µg/L	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.086	0.0375	0.086	0.036
	Heptachlor	µg/L	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.52	0.0038	0.52	0.0038
	Heptachlor Epoxide	µg/L	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250			0.52	0.0038
	Methoxychlor	µg/L	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500				0.03
	Toxaphene	µg/L	0.850	0.850	0.850	0.850	0.850	0.850	0.73	0.0002	0.73	0.0002
Semi-Volatile Organic Compounds	Hexachlorobutadiene	µg/L	5.00	3.75	5.00	3.75	5.00	3.75	5.1	1.02		

Table 6– Exceedances of State hardness-dependent metals criteria

		Parameter										LDEQ Water Quality Criteria for Metals (Harness-Dependent for Freshwater/Brackish Criteria)									
		Cadmium		Copper		Lead		Nickel		Zinc		Cadmium		Copper		Lead		Nickel		Zinc	
		µg/L		µg/L		µg/L		µg/L		µg/L											
Salinity Regime	Station ID	Elutriate	Water	Elutriate	Water	Elutriate	Water	Elutriate	Water	Elutriate	Water	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic
Freshwater	Site 1	2.5	2.5	17	5	14	1.5	16	7.5	35	6	22.1	0.944	14.7	10.0	29.5	2.02	1,155	128	93.4	85.3

For brackish sites (**Table 7 and 8**), the only measured concentration exceeding criteria was for ammonia (Site 5, elutriate).

Results below the laboratory reporting limit, when estimated as one-half of the laboratory reporting limit, exceeded acute criteria for copper, silver, p,p'-DDD, beta-endosulfan, endrin, toxaphene, and hexachlorobutadiene for all brackish sites and both analytical media, and chronic criteria for copper, mercury, silver, p,p'-DDD, p,p'-DDT, dieldrin, alpha-endosulfan, beta-endosulfan, endrin, heptachlor, heptachlor epoxide, methoxychlor, toxaphene, and hexachlorobutadiene for all brackish sites and both analytical media.

Table 7 – Exceedances of water quality criteria for brackish sites

Chemical Class	Parameter	Units	Brackish Site 3 Elutriate	Brackish Site 3 Water	Site 4 Elutriate	Site 4 Water	Site 5 Elutriate	Site 5 Water	Site 6 Elutriate	Site 6 Water	Site 8 Elutriate	Site 8 Water	Site 9 Elutriate	Site 9 Water	Site 10 Elutriate	Site 10 Water	Water Quality Criteria LDEQ Brackish Acute	LDEQ Brackish Chronic	EPA Marine Acute	EPA Marine Chronic
Metals	Copper	µg/L	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	b		4.8	3.1
	Mercury	µg/L	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	2.00	0.012	1.8	0.94
	Silver	µg/L	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50			1.9	
Pesticides	DDD, p,p'-	µg/L	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.03	0.006		
	DDT, p,p'-	µg/L	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.13	0.001	0.13	0.001
	Dieldrin	µg/L	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.237	0.0019	0.71	0.0019
	Endosulfan, alpha-	µg/L	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.034	0.0087	0.034	0.0087
	Endosulfan, beta-	µg/L	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500			0.034	0.0087
	Endrin	µg/L	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.037	0.0023	0.037	0.0023
	Heptachlor	µg/L	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.053	0.0036	0.053	0.0036
	Heptachlor Epoxide	µg/L	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250			0.053	0.0036
	Methoxychlor	µg/L	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500				0.03
	Toxaphene	µg/L	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.21	0.0002	0.21	0.0002
Semi-Volatile Organic Compounds	Hexachlorobutadiene	µg/L	5.00	3.75	5.00	3.75	5.00	3.75	5.00	3.75	5.00	3.75	5.00	3.75	5.00	3.75	1.6	0.32		

Table 8 – Exceedances of Federal criteria for ammonia

Salinity Regime	Station ID	Nitrogen, Ammonia mg/L Elutriate	Water	Marine Acute	Marine Chronic
Brackish	Site 5	3.90	0.066	25	3.7

For marine sites (**Table 9**), no exceedances of measured values were reported.

Results below the laboratory reporting limit, when estimated as one-half of the laboratory reporting limit, exceeded acute criteria for silver, beta-endosulfan, endrin, toxaphene, and hexachlorobutadiene for all marine sites and both media, and chronic criteria for mercury, silver, p,p'-DDT, dieldrin, alpha-endosulfan, beta-endosulfan, endrin, heptachlor, heptachlor epoxide, methoxychlor, toxaphene, and hexachlorobutadiene for all marine sites and both media.

9 – Exceedances of water quality criteria for marine sites

Chemical Class	Parameter	Units	Marine Site 7 Elutriate	Site 7 Water	Site 11 Elutriate	Site 11 Water	Water Quality Criteria LDEQ Marine Acute	LDEQ Marine Chronic	EPA Marine Acute	EPA Marine Chronic
Metals	Mercury	µg/L	0.100	0.260	0.100	0.100	2	0.025	1.8	0.94
	Silver	µg/L	2.50	2.50	2.50	2.50			1.9	
Pesticides	DDT, p,p'-	µg/L	0.0500	0.0500	0.0500	0.0500	0.13	0.001	0.13	0.001
	Dieldrin	µg/L	0.0500	0.0500	0.0500	0.0500	0.71	0.0019	0.71	0.0019
	Endosulfan, alpha-	µg/L	0.0250	0.0250	0.0250	0.0250	0.034	0.0087	0.034	0.0087
	Endosulfan, beta-	µg/L	0.0500	0.0500	0.0500	0.0500			0.034	0.0087
	Endrin	µg/L	0.0500	0.0500	0.0500	0.0500	0.037	0.0023	0.037	0.0023
	Heptachlor	µg/L	0.0250	0.0250	0.0250	0.0250	0.053	0.0036	0.053	0.0036
	Heptachlor Epoxide	µg/L	0.0250	0.0250	0.0250	0.0250			0.053	0.0036
	Methoxychlor	µg/L	0.0500	0.0500	0.0500	0.0500				0.03
	Toxaphene	µg/L	0.850	0.850	0.850	0.850	0.21	0.0002	0.21	0.0002
Semi-Volatile Organic Compounds	Hexachlorobutadiene	µg/L	5.00	3.75	5.00	3.75	1.6	0.32		

Sediment Quality

Tables 10 - 11 below display exceedances of NOAA sediment screening values. In most cases, values exceeding screening values are not measured values, but are instead estimates, as results were below the laboratory reporting limit.

For freshwater sites (**Table 10**), the measured concentrations for arsenic, copper, nickel, and zinc exceeded freshwater Lowest Effect Level (LEL) screening values at all freshwater sites, while the measured value for mercury at Site 12 exceeded the freshwater LEL screening value.

Results below the laboratory reporting limit, when estimated as one-half of the laboratory reporting limit, exceeded sediment screening values at all freshwater sites for the following parameters: antimony, mercury, silver, aldrin, gamma-BHC, p,p'-DDD, p,p'-DDE, p,p'-DDT, dieldrin, endrin, heptachlor epoxide, toxaphene acenaphthene, acenaphthalene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, phenanthrene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, and naphthalene.

Table 10 – Exceedances of sediment screening values for freshwater sites

			Freshwater			NOAA Sediment Screening Values for Freshwater Sediment — Predicted Toxicity Gradient: Increasing →							
Chemical Class	Parameter	Units	Site 1	Site 2	Site 12	ARCS Hyalella TEL	TEL	TEC	LEL	PEL	PEC	SEL	UET
Metals	Antimony	µg/kg	1,950	2,800	4,850								3,000 M
	Arsenic	µg/kg	6,600	4,400	6,400	10,798	5,900	9,790	6,000	17,000	33,000	33,000	17,000 I
	Copper	µg/kg	21,100	16,300	31,700	28,012	35,700	31,600	16,000	197,000	149,000	110,000	86,000 I
	Mercury	µg/kg	55.0	75.0	255		174	180	200	486	1,060	2,000	560 M
	Nickel	µg/kg	19,600	16,000	25,600	19,514	18,000	22,700	16,000	36,000	48,600	75,000	43,000 H
	Silver	µg/kg	325	465	800				500				4,500 H
	Zinc	µg/kg	81,500	61,100	152,000	98,000	123,000	121,000	120,000	315,000	459,000	820,000	520,000 M
Pesticides	Aldrin	µg/kg	1.15	1.60	2.75				2.00			80.0	40.0 I
	BHC, gamma-	µg/kg	1.15	1.60	2.75		0.940	2.37	3.00	1.38	4.99	10.0	9.00 I
	DDD, p,p'-	µg/kg	2.25	3.10	5.35		3.54	4.88	8.00	8.51	28.0	60.0	60.0 I
	DDE, p,p'-	µg/kg	2.25	3.10	5.35		1.42	3.16	5.00	6.75	31.3	190	50.0 I
	DDT, p,p'-	µg/kg	2.25	3.10	5.35		1.19 c	4.16	8.00	4.77 c	62.9	710	50.0 I
	Dieldrin	µg/kg	2.25	3.10	5.35		2.85	1.90	2.00	6.67	61.8	910	300 I
	Endrin	µg/kg	2.25	3.10	5.35		2.67	2.22	3.00	62.4	207	1,300	500 I
	Heptachlor Epoxide	µg/kg	1.15	1.60	2.75		0.600	2.47	5.00	2.74	16.0	50.0	30.0 I
	Toxaphene	µg/kg	22.4	31.2	53.5		0.100 c						
Polycyclic Aromatic Hydrocarbons	Acenaphthene	µg/kg	224	312	535		6.71 c			88.9 c			290 M
	Acenaphthylene	µg/kg	224	312	535		5.87 c			128 c			
	Anthracene	µg/kg	224	312	535	10.0	46.9 c	57.2	220	245 c	845	3,700	260 M
	Benzo(a)anthracene	µg/kg	224	312	535	15.7	31.7	108	320	385	1,050	14,800	500 I
	Benzo(a)pyrene	µg/kg	224	312	535	32.4	31.9	150	370	782	1,450	14,400	700 I
	Benzo(g,h,i)perylene	µg/kg	224	312	535				170			3,200	300 M
	Benzo(k)fluoranthene	µg/kg	224	312	535	27.2			240			13,400	13,400 B
	Phenanthrene	µg/kg	224	312	535	18.7	41.9	204	560	515	1,170	9,500	800 I
Semi-Volatile Organic Compounds	Chrysene	µg/kg	224	312	535	26.8	57.1	166	340	862	1,290	4,600	800 I
	Dibenzo(a,h)anthracene	µg/kg	224	312	535	10.0	6.22 c	33.0	60.0	135 c		1,300	100 M
	Fluoranthene	µg/kg	224	312	535	31.5	111	423	750	2,355	2,230	10,200	1,500 M
	Fluorene	µg/kg	224	312	535	10.0	21.2 c	77.4	190	144 c	536	1,600	300 M
	Naphthalene	µg/kg	113	157	271	14.7	34.6 c	176		391 c	561		600 I

For brackish sites (**Table 11**), sediment screening values were exceeded for measured or estimated (j-flagged, not below the laboratory reporting limit) concentrations of aluminum (AET at all sites), antimony (T_{20} at sites 8, 9, and 10; T_{50} at sites 3, 4, and 5), arsenic (ERL at Site 9), barium (TEL at sites 3, 4, 5, 6, 9, and 10), cobalt (AET at Site 9), copper (TEL at sites 3, 4, and 5; ERL at Site 6), manganese (AET at sites 3, 4, 6, 8, 9, and 10), nickel (TEL at sites 3, 4, 8, and 10; ERL at sites 5, 6, and 9), zinc (T_{20} at sites 4, 5, and 6; TEL at Site 3), benzo(a)anthracene (ERL at Site 3), benzo(a)pyrene (T_{50} at Site 3), benzo(b)fluoranthene (T_{20} at sites 4 and 8; T_{50} at Site 3), benzo(g,h,i)perylene (T_{20} at Site 3), phenanthrene (PEL at Site 5), chrysene (ERL at Site 3), fluoranthene (TEL at sites 3 and 6), pyrene (ERL at Site 3; TEL at Site 6), and Indeno(1,2,3-cd)pyrene (T_{20} at Site 3). With the exception of the measured phenanthrene concentration for Site 5, no measured values exceeded PEL or ERM screening values.

Results below the laboratory reporting limit, when estimated as one-half of the laboratory reporting limit, exceeded sediment screening values at all brackish sites for the following parameters: mercury, silver, gamma-BHC, p,p'-DDD, p,p'-DDE, p,p'-DDT, dieldrin, heptachlor, heptachlor epoxide, toxaphene, acenaphthene, acenaphthylene, anthracene, benzo(k)fluoranthene, benzoic acid, benzyl alcohol, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, o-cresol, p-cresol, dibenzo(a,h)anthracene, dibenzofuran, 2,4-dimethylphenol, fluorine, hexachlorobenzene, 2-methylnaphthalene, naphthalene, nitrobenzene, and n-nitrosodiphenylamine. For benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, phenanthrene, chrysene, fluoranthene, pyrene, and indeno(1,2,3-cd)pyrene, estimated concentrations for sites with results below the laboratory reporting limit also exceeded sediment screening values.

Table 11 – Exceedances of sediment screening values for brackish sites

Chemical Class	Parameter	Units	Brackish							NOAA Sediment Screening Values for Marine Sediment — Predicted Toxicity Gradient — Increasing →							
			Site 3	Site 4	Site 5	Site 6	Site 8	Site 9	Site 10	T20	TEL	ERL	T50	PEL	ERM	AET	Eco Tox EqP
Metals	Aluminum	µg/kg	11,400,000	12,100,000	16,200,000	12,800,000	6,580,000	12,200,000	9,020,000							0.0180 N	
	Antimony	µg/kg	2,850	3,200	5,250	2,600	1,800	1,900	1,900	630			2,400			9,300 E	
	Arsenic	µg/kg	5,500	3,900	4,500	6,800	4,000	16,200	6,100	7,400	7,240	8,200	20,000	41,600	70,000	35,000 B	
	Barium	µg/kg	513,000	181,000	212,000	375,000	106,000	359,000	322,000		130,100 #						
	Cobalt	µg/kg	8,900	5,400	8,900	9,000	6,500	23,600	6,700							10,000 N	
	Copper	µg/kg	22,400	21,400	23,600	38,700	10,900	16,600	16,100	32,000	18,700	34,000	94,000	108,000	270,000	390,000 MO	
	Manganese	µg/kg	395,000	383,000	253,000	678,000	319,000	1,100,000	349,000							260,000 N	
	Mercury	µg/kg	85.0	90.0	140	75.0	55.0	60.0	55.0	140	130	150	480	700	710	410 M	
	Nickel	µg/kg	17,600	17,100	23,100	21,900	15,900	25,000	17,200	15,000	15,900	20,900	47,000	42,800	51,600	110,000 EL	
	Silver	µg/kg	475	550	800	430	300	320	315	230	730	1,000	1,100	1,770	3,700	3,100 B	
	Zinc	µg/kg	128,000	108,000	121,000	113,000	70,900	71,400	76,600	94,000	124,000	150,000	245,000	271,000	410,000	410,000 I	
Pesticides	BHC, gamma-	µg/kg	1.80	1.95	2.95	1.60	1.15	1.25	1.20		0.320			0.990		4.80 N	3.70
	DDD, p,p'-	µg/kg	3.55	3.80	5.75	3.05	2.25	2.40	2.30		1.22	2.00		7.81	20.0	16.0 I	
	DDE, p,p'-	µg/kg	3.55	3.80	5.75	3.05	2.25	2.40	2.30		2.07	2.20		374	27.0	9.00 I	
	DDT, p,p'-	µg/kg	3.55	3.80	5.75	3.05	2.25	2.40	2.30		1.19	1.00		4.77	7.00	12.0 E	
	Dieldrin	µg/kg	3.55	3.80	5.75	3.05	2.25	2.40	2.30	0.830	0.720	0.0200	2.90	4.30	8.00	1.90 E	
	Heptachlor	µg/kg	1.80	1.95	2.95	1.60	1.15	1.25	1.20							0.300 B	
	Heptachlor Epoxide	µg/kg	1.80	1.95	2.95	1.60	1.15	1.25	1.20	0.600 c				2.74 c			
	Toxaphene	µg/kg	35.3	38.0	57.5	30.6	22.5	24.1	22.9		0.100 c						28.0
Polycyclic Aromatic Hydrocarbons	Acenaphthene	µg/kg	353	380	575	306	225	241	229	19.0	6.71	16.0	116	88.9	500	130 E	
	Acenaphthylene	µg/kg	353	380	575	306	225	241	229	14.0	5.87	44.0	140	128	640	71.0 E	
	Anthracene	µg/kg	353	380	575	306	225	241	229	34.0	46.9	85.3	290	245	1,100	280 E	
	Benzo(a)anthracene	µg/kg	288	380	575	306	225	241	229	61.0	74.8	261	466	693	1,600	960 E	
	Benzo(a)pyrene	µg/kg	637	380	575	306	225	241	229	69.0	88.8	430	520	763	1,600	1,100 E	
	Benzo(b)fluoranthene	µg/kg	1,130	182	575	306	185	241	229	130			1,107			1,800 EI	
	Benzo(g,h,i)perylene	µg/kg	292	380	575	306	225	241	229	67.0			497			670 M	
	Benzo(k)fluoranthene	µg/kg	366	380	575	306	225	241	229	70.0			537			1,800 EI	
	Phenanthrene	µg/kg	142	380	575	306	225	241	229	68.0	86.7	240	455	544	1,500	660 E	
Semi-Volatile Organic Compounds	Benzoic Acid	µg/kg	353	380	575	306	225	241	229							65.0 O	
	Benzyl Alcohol	µg/kg	353	380	575	306	225	241	229							52.0 B	
	Bis(2-Ethylhexyl) Phthalate	µg/kg	353	380	575	306	225	241	229		182			2,647		1,300 I	
	Butyl Benzyl Phthalate	µg/kg	353	380	575	306	225	241	229							63.0 M	1,100
	Chrysene	µg/kg	476	380	575	306	225	241	229	120	108	384	650	846	2,800	950 E	
	Cresol, o-	µg/kg	353	380	575	306	225	241	229							8.00 B	
	Cresol, p-	µg/kg	353	380	575	306	225	241	229							100 B	
	Dibenzo(a,h)anthracene	µg/kg	353	380	575	306	225	241	229	19.0	6.22	63.4	113	135	260	230 OM	
	Dibenzofuran	µg/kg	353	380	575	306	225	241	229							110 E	2,000
	Dimethylphenol, 2,4-	µg/kg	353	380	575	306	225	241	229							18.0 N	
	Fluoranthene	µg/kg	591	380	575	124	225	241	229	119	113	600	1,034	1,494	5,100	1,300 E	
	Fluorene	µg/kg	353	380	575	306	225	241	229	19.0	21.2	19.0	114	144	540	120 E	540
	Hexachlorobenzene	µg/kg	353	380	575	306	225	241	229							6.00 B	
	Methylnaphthalene, 2-	µg/kg	353	380	575	306	225	241	229	21.0	20.2	70.0	128	201	670	64.0 E	
	Naphthalene	µg/kg	179	193	292	155	114	122	116	30.0	34.6	160	217	391	2,100	230 E	480
	Nitrobenzene	µg/kg	353	380	575	306	225	241	229							21.0 N	
	N-Nitrosodiphenylamine	µg/kg	353	380	575	306	225	241	229							28.0 I	
	Pyrene	µg/kg	796	380	575	198	225	241	229	125	153	665	932	1,398	2,600	2,400 E	
	Pyrene, Indeno(1,2,3-cd)	µg/kg	345	380	575	306	225	241	229	68.0			488			600 M	

For marine sites (**Table 12**), sediment screening values were exceeded for measured concentrations of aluminum (T_{20} at Site 11; T_{50} at Site 7), arsenic (ERL at Site 11), barium (TEL at Site 11), cobalt (AET at Site 11), copper (TEL at both sites), manganese (AET at both sites), and nickel (ERL at both sites), and for the estimated (j-flagged, not below the laboratory reporting limit) concentration of butyl benzyl phthalate at Site 7. No measured values exceeded PEL or ERM screening values.

Results below the laboratory reporting limit, when estimated as one-half of the laboratory reporting limit, exceeded sediment screening values at both marine sites for the following parameters: silver, gamma-BHC, p,p'-DDD, p,p'-DDE, p,p'-DDT, dieldrin, heptachlor, heptachlor epoxide, toxaphene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, phenanthrene, benzoic acid, benzyl alcohol, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, o-cresol, p-cresol, dibenzo(a,h)anthracene, dibenzofuran, 2,4-dimethylphenol, fluoranthene, fluorene, hexachlorobenzene, 2-

methylnaphthalene, naphthalene, nitrobenzene, n-nitrosodiphenylamine, pyrene, and indeno(1,2,3-cd)pyrene. The concentration for butyl benzyl phthalate at Site 11, when estimated as one-half of the laboratory reporting limit, also exceeded the AET screening value.

Table 12 – Exceedances of sediment screening values for marine sites

			Marine		NOAA Sediment Screening Values for Marine Sediment — Predicted Toxicity Gradient: Increasing →							
Chemical Class	Parameter	Units	Site 7	Site 11	T20	TEL	ERL	T50	PEL	ERM	AET	Eco Tox EqP
Metals	Aluminum	µg/kg	8,770,000	14,100,000							0.0180 N	
	Antimony	µg/kg	4,100	2,200	630			2,400			9,300 E	
	Arsenic	µg/kg	4,500	10,300	7,400	7,240	8,200	20,000	41,600	70,000	35,000 B	
	Barium	µg/kg	95,500	201,000		130,100 #						
	Cobalt	µg/kg	7,200	10,900							10,000 N	
	Copper	µg/kg	20,600	22,200	32,000	18,700	34,000	94,000	108,000	270,000	390,000 MO	
	Manganese	µg/kg	307,000	630,000							260,000 N	
	Nickel	µg/kg	35,200	26,400	15,000	15,900	20,900	47,000	42,800	51,600	110,000 EL	
	Silver	µg/kg	700	365	230	730	1,000	1,100	1,770	3,700	3,100 B	
Pesticides	BHC, gamma-	µg/kg	2.30	1.25		0.320			0.990		4.80 N	3.70
	DDD, p,p'-	µg/kg	4.50	2.40		1.22	2.00		7.81	20.0	16.0 I	
	DDE, p,p'-	µg/kg	4.50	2.40		2.07	2.20		374	27.0	9.00 I	
	DDT, p,p'-	µg/kg	4.50	2.40		1.19	1.00		4.77	7.00	12.0 E	
	Dieldrin	µg/kg	4.50	2.40	0.830	0.720	0.0200	2.90	4.30	8.00	1.90 E	
	Heptachlor	µg/kg	2.30	1.25							0.300 B	
	Heptachlor Epoxide	µg/kg	2.30	1.25	0.600 c				2.74 c			
	Toxaphene	µg/kg	45.1	24.1		0.100 c						28.0
Polycyclic Aromatic Hydrocarbons	Acenaphthene	µg/kg	451	241	19.0	6.71	16.0	116	88.9	500	130 E	
	Acenaphthylene	µg/kg	451	241	14.0	5.87	44.0	140	128	640	71.0 E	
	Anthracene	µg/kg	451	241	34.0	46.9	85.3	290	245	1,100	280 E	
	Benzo(a)anthracene	µg/kg	451	241	61.0	74.8	261	466	693	1,600	960 E	
	Benzo(a)pyrene	µg/kg	451	241	69.0	88.8	430	520	763	1,600	1,100 E	
	Benzo(b)fluoranthene	µg/kg	451	241	130			1,107			1,800 EI	
	Benzo(g,h,i)perylene	µg/kg	451	241	67.0			497			670 M	
	Benzo(k)fluoranthene	µg/kg	451	241	70.0			537			1,800 EI	
	Phenanthrene	µg/kg	451	241	68.0	86.7	240	455	544	1,500	660 E	
Semi-Volatile Organic Compounds	Benzoic Acid	µg/kg	451	241							65.0 O	
	Benzyl Alcohol	µg/kg	451	241							52.0 B	
	Bis(2-Ethylhexyl) Phthalate	µg/kg	382	144		182			2,647		1,300 I	
	Butyl Benzyl Phthalate	µg/kg	551	241							63.0 M	1,100
	Chrysene	µg/kg	451	241	82.0	108	384	650	846	2,800	950 E	
	Cresol, o-	µg/kg	451	241							8.00 B	
	Cresol, p-	µg/kg	451	241							100 B	
	Dibenzo(a,h)anthracene	µg/kg	451	241	19.0	6.22	63.4	113	135	260	230 OM	
	Dibenzofuran	µg/kg	451	241							110 E	2,000
	Dimethylphenol, 2,4-	µg/kg	451	241							18.0 N	
	Fluoranthene	µg/kg	451	241	119	113	600	1,034	1,494	5,100	1,300 E	
	Fluorene	µg/kg	451	241	19.0	21.2	19.0	114	144	540	120 E	540
	Hexachlorobenzene	µg/kg	451	241							6.00 B	
	Methylnaphthalene, 2-	µg/kg	451	241	21.0	20.2	70.0	128	201	670	64.0 E	
	Naphthalene	µg/kg	228	122	30.0	34.6	160	217	391	2,100	230 E	480
	Nitrobenzene	µg/kg	451	241							21.0 N	
	N-Nitrosodiphenylamine	µg/kg	451	241							28.0 I	
	Pyrene	µg/kg	451	241	125	153	665	932	1,398	2,600	2,400 E	
	Pyrene, Indeno (1,2,3-cd)	µg/kg	451	241	68.0			488			600 M	

With the exception of sediment phenanthrene measurements at Site 5, all other measured concentrations exceeding sediment screening values for those indicative of low-level contamination. In addition, adjacent borrow material is expected to have characteristics similar to sediments present at the proposed placement sites. Therefore, no significant changes in sediment quality at the placement sites are anticipated.

The proposed hurricane protection project could have significant indirect impacts on contaminant levels in the study area, the extent to which is largely unknown. Based on historical water quality information for the study area, it is clear that a majority of the water quality problems within the study area occur on the protected side of the proposed levee alignment (see the *Morganza to the Gulf of Mexico, Louisiana Draft PAC Draft Engineering Appendix* for details). Although the modeling report *Comparison of Plan*

Alternatives for the Morganza to the Gulf of Mexico Levee System suggests that proper management of gates and tidal exchange structures can minimize changes in flow and water level between the flood and protected side of the proposed levee alignment, it is a legitimate concern that the proposed alignment will cause significant alteration of hydrology and hydraulics in the study area, such that water exchange between the protected and flood sides of the proposed levee alignment is significantly inhibited, and that localized areas of stagnation behind the levee alignment may occur. If these conditions present themselves, the levee alignment would serve as a barrier between relatively free of contamination Gulf of Mexico waters and impaired waters, further exacerbating water quality conditions on the protected side of the alignment while maintaining or improving the health of waters on the flood side. Moreover, the potential expansion of developed areas as a result of the project could lead to additional point and nonpoint discharges within the hurricane protection system, which would further degrade water quality on the protected side of the propose alignment. Also, as sea-level rise increases water levels in the study area, the frequency with which environmental water control structures are closed could increase provided it is authorized, causing further stagnation for waters on the protected side of the proposed levee alignment.

Hydrology plays a major role in biogeochemical cycling in wetlands (Mitsch and Gosselink 2000); therefore, operation of these structures is expected to have a significant impact on biogeochemical cycling for wetlands in the study area, particularly on the protected side of the proposed levee alignment. This could be beneficial or detrimental, depending on the operation of gates and tidal exchange structures and impediment of flow caused by the proposed hurricane protection system.

A major potential benefit of the project is that it would provide for the protection of marshes on the flood side of the proposed levee alignment, potentially extending the lifespan of these marshes. However, the marshes just outside of the hurricane protection system are expected to be subjected to an increase in wave energy as a result of the proposed project, which could lead to the accelerated loss of unprotected marsh vegetation. This detracts from rationale for utilizing the topmost organic sediment layer of adjacent levee borrow areas for marsh construction on the flood side of the proposed levee alignment. Similar to on the protected side of the proposed levee alignment, wetland loss on the flood side could negatively affect water quality via the decrease in area of wetlands vegetation capable of filtering pollutants and nutrients, increases in suspended solids and turbidity, and releases of constituents stored by deteriorating wetlands vegetation.

e. <u>Aquatic Ecosystem and Organism Determinations</u>

(1) Effects on Plankton. Section 6.4.2 of the RPDEIS goes into details on the impacts to this resource. During actual construction activities of project features there would only be short-term minor adverse impacts to plankton populations due to increases in turbidity, low DO, and introduction of dredged sediments into shallow open water areas. There would be long-term loss of shallow water habitats due to dredge disposal activities. However, there is an abundance of shallow open water habitat available for use by plankton.

(2) Effects on Benthos. Section 6.4.1 of the RPDEIS goes into details on the impacts to benthic resources. Direct effects on benthic habitat include covering and smothering of benthic organisms in association with levee construction and similar activities in wetlands and aquatic habitats. Borrow material removed from aquatic and wetland habitats would result in a temporary loss of the benthic organisms followed by re-colonization from adjacent areas, however, because of a change in depth and other habitat characteristics, the structure of the benthic community may be altered.

(3) Effects on Nekton. Nekton are largely comprised of animals from three clades; vertebrates, mollusks, and crustaceans. Direct impacts to nekton from implementation of the proposed action would result from construction of project features. Impacts from construction of water control structures may include direct mortality due to burial or sudden salinity changes; injury or mortality due to increased turbidity (e.g. gill abrasion, clogging of feeding apparatus); modified behavior, and short-term displacement. Dredging and placement of borrow material associated with dredge features, levee construction, and marsh creation would negatively impact benthic organisms and benthic feeders in dredge channels and disposal areas. Sessile and slow-moving aquatic invertebrates would be disturbed by the dredge or excavation activity or buried by the placed material. Construction activities would temporarily increase turbidity, temperatures, and biological oxygen demand (BOD), and decrease dissolved oxygen. These temporary conditions would likely displace more mobile nekton from the construction area. Following construction, displaced nekton would likely return to the project area.

(4) Effects on the Aquatic Food Web. *Mitigation Sites:* The aquatic food web at the mitigation sites are expected to be affected for a period of a few months after the deposition of dredged material. Populations of organisms at all levels of the food web would be decreased or eliminated in the vicinity of the disposal site from a combination of effects including turbidity, decreased DO, physical burying and displacement. The decrease in light penetration from increased turbidity would cause a decline of phytoplankton populations. This decline in primary productivity would also reduce zooplankton populations and populations of filter feeders and other high order predators. A viable food web is expected to reestablish after the completion of disposal activities and consolidation of sediments.

(5) Effects on Special Aquatic Sites.

> (a) Sanctuaries and Refuges. Coordination has occurred and would continue with US Fish and Wildlife Service and Louisiana Department of Fish and Wildlife concerning construction in the Mandalay National Wildlife Refuge and Pointe Aux Chenes Wildlife Management Area.

(b) Wetlands. Section 6.2.2 of the RPDEIS goes into details on the impacts to wetlands. The constructible components of the 1% AEP Alternative would result in the filling of wetlands and their conversion to uplands and open water. The table below summaries the acres affected by the projects' constructible features. These impacts will be mitigated for as part of the proposed action.

Acres of Wetlands Directly Effected			
Features	**Tidal Wetlands**	**Force Drained Wetlands**	**Total wetlands**
Constructible Features	644.35	25.98	670.33
Programmatic Features	4,047	57	4,104

(c) Mud Flats. Section 6.6.2 of the RPDEIS goes into details on the impacts to Essential Fish Habitat (EFH). Mud Flats are one the EFH in the project area.

(d) Vegetated Shallows. Section 6.6.2 of the RPDEIS goes into details on the impacts to EFH. Vegetated shallows are one the EFH in the project area. Construction activities using earthen materials to create wetland mitigation areas along the proposed right of way could bury EFH substrates or temporarily change environmental conditions, including turbidity and salinity, in the water column. These impacts would be minimized, as much as practicable, through implementation of appropriate Best Management Practices. The project would increase SAV and adjacent intertidal marsh vegetation (marsh creation areas) in some areas and decrease vegetation in other areas (levee construction areas).

(e) Coral Reefs. Not Applicable

(f) Riffle and Pool Complexes. Not Applicable

(6) Threatened and Endangered Species. Section 6.8.2 of the RPDEIS goes into details on the impacts to this resource. No direct impacts on threatened or endangered species would result from implementation of the 1% AEP Alternative.

(7) Other Wildlife. Section 6.7.2 of the RPDEIS goes into details on the impacts to this resource. Wildlife species using the marsh and open water habitat in the proposed right of way could easily avoid disturbances associated with construction activities. Birds would have ample alternative locations available for use. Mammals or reptiles that may inhabit the proposed construction areas would likely react to disturbances by relocating to adjacent marsh or open water habitats. Once the levee is constructed, it would provide additional upland habitat that may be valuable to some terrestrial wildlife species, such as snakes, lizards, terrapins, and rodents.

(8) Actions to Minimize Impacts. Formulation of project plans and designs, evaluation of alternative plans, and development of operational scenarios for the preferred alternative, have all been conducted with the objective of minimizing potential negative impacts to the aquatic ecosystem.

- Follow the National Bald Eagle Management Guidelines.
- During investigations for programmatic features look for ways to reduce levee foot print.
- Use best management practices to reduce runoff and turbidity during construction.

f. <u>Proposed Disposal Site Determinations</u>

(1) Mixing Zone Determination.

(All Features)
Because of the nature of sediment excavation and placement (dredged material will be excavated with a bucket dredge, allowed to dewater, and then placed for levee construction), very little dredged material effluent will be generated. In addition, elutriate tests conducted (which would be extremely conservative estimates of dissolved contaminant concentrations present in effluent generated during mechanical disposal or dewatered sediments) do not indicate the proposed disposal activity will have significant water column impacts (the highest exceedance observed is within one order of magnitude of chronic water quality criteria, while the only observed exceedance of acute criteria, for copper in the Site 1 elutriate sample, would be readily diluted by site water, having a dilution factor of -0.767). Therefore, there does not appear to be a reason to believe that disposal of mechanically dredged, dewatered dredged material will exceed water quality criteria outside of the proposed mixing zone.

(2) Determination of Compliance with Applicable Water Quality Standards.

(All Features)
There does not appear to be a reason to believe that disposal of mechanically dredged, dewatered dredged material will exceed water quality criteria outside of the proposed mixing zone; therefore, based on best available information, direct impacts from construction of the proposed project are expected to be in compliance with applicable water quality standards. As discussed in earlier sections (in particular, subparts II.b.1(g) and II.b.1(h)) and in the *Morganza to the Gulf of Mexico, Louisiana Draft PAC Draft Engineering Appendix*, there is a long-term potential for indirectly affecting subsegment support, especially for subsegments on the protected side of the proposed levee alignment.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and private water supply.

(All Features)
The project would have a beneficial effect on water supplies. The multipurpose HNC Lock Complex would be constructed and operated as part of the Project to control storm surge and saltwater intrusion. The HNC Lock Complex would be operated to reduce salinity intrusion in the Houma Navigation Canal, thus reducing the raw source water salinity for the Houma Water Treatment Plant.

(b) Recreational and commercial fisheries. Recreational and commercial activities in the project area are based on vessel activity. There would be a minimum impact by the dredging and disposal activities. U.S. Coast Guard regulations, such as marine safety zones would be strictly adhered to for assurance of safe vessel passage. The area would return to pre-project conditions upon construction completion. Disposal areas would become a new feature of the landscape.

(c) Water-related recreation. Water related recreation would experience a minimum inconvenience at the time of dredging and disposal operations, but would return to pre-project conditions after project completion.

(d) Aesthetics. The aesthetics of the project area at the time of construction would be characterized by the presence of the dredge and other project associated equipment and exposed mud at the disposal sites. This is considered temporary and local natural vegetation would quickly take root improving the aesthetics within the first and second growing seasons.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar preserves. The study area includes Mandalay National Wildlife Refuge and Pointe Aux Chenes Wildlife Management Area. Direct impacts to wetlands in these areas will be mitigated for as part of the project.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. Cumulative effects on the coastal ecosystem would primarily be related to the incremental impact of all past, present, and future actions affecting water quality within the Basin such as: increase in fresh water areas; stabilization or decrease in salinities; increase in sediment introduction to the coastal zone, with accompanying minor increases in trace metals associated with bed sediments; increased total suspended sediments; increased turbidity; increased organic/nutrient enrichment of the water column; disturbance and release of possible contaminants; decrease in water temperatures along with fewer water temperature fluctuations; and increased dissolved oxygen levels. Temporary turbidity impacts may occur on- and off-site during construction of project features, but would be short-term in duration. Negative impacts due to loss of wetlands from creating the levee would be mitigated for. No long-term, negative cumulative impacts are anticipated.

h. Determination of Secondary Effects on the Aquatic Ecosystem. Indirect impacts to oyster leases could include increased rate of mortality and decrease in productivity in oyster leases located closest to the construction sites.

III. Findings of Compliance or Non-compliance with the Restrictions on Discharge

a. Adaptation of the Section 404(b)(1) Guidelines to this Evaluation were not significant.

b. No practicable alternatives to the proposed discharges could be identified that would have less adverse impacts on the aquatic ecosystem.

c. Compliance with Applicable State Water Quality Standards was met.

d. Compliance with Applicable Toxic Effluent Standard or Prohibition Under Section 307 of the Clean Water Act was met

e. The proposed action is compliant with the Endangered Species Act of 1973, as amended. The proposed action would not adversely affect endangered or threatened species or their critical habitats.

f. The proposed action is compliant with specified protection measures for marine sanctuaries designated by the Marine Protection, Research, and Sanctuaries Act of 1972. All disposal sites and effects are inland waters. No effects would occur in ocean waters beyond the shoreline of the Gulf of Mexico.

g. Evaluation of Extent of Degradation of the Waters of the United States

(1) Significant Adverse Effects on Human Health and Welfare

(a) Municipal and Private Water Supplies. There would be short-term direct impacts to municipal or private water supplies.

(b) Recreational and Commercial Fisheries. There would be short-term direct impacts to recreational and commercial fishing due to increases in turbidity, low DO, and introduction of dredged sediments into shallow open water areas. The immediate area would be unavailable for fishing during construction.

(c) Plankton. There would be short-term direct impacts to plankton populations due to increases in turbidity, low DO, and introduction of dredged sediments into shallow open water areas. There would be long-term loss of shallow water habitats in some areas due to dredge disposal activities. However, overall, there is an abundance of shallow open water habitat in the project area available for use by plankton.

(d) Fish. Temporary conditions would likely displace more mobile fisheries species from the construction area. Following construction, displaced fish would likely return to the project area.

(e) Shellfish. No measurable direct impacts to oysters are anticipated to result from placement of dredged material.

(f) Wildlife. Temporary low DO and turbidity caused by placement of dredged material is unlikely to affect wildlife.

(g) Special Aquatic Sites. The study area includes Mandalay National Wildlife Refuge and Pointe Aux Chenes Wildlife Management Area. There will be direct impacts to the refuge and management area anticipated from implementation of the proposed action. Wetlands are the major special aquatic sites in the project area. There would be loss of wetlands with the placement of material to create the levees. This loss of functions and values are being mitigated for by the creation of marsh.

(2) Significant Adverse Effects on Life Stages of Aquatic Life and Other Wildlife Dependent on Aquatic Ecosystems. Impacts to early life stages may occur during placement of dredged material, but they are expected to diminish after project completion. The mitigated marsh would provide a nursery area for early life stages of many fish and shellfish.

(3) Significant Adverse Effects on Aquatic Ecosystem Diversity, Productivity, and Stability. Ecosystem diversity and productivity would be expected to remain the same with the mitigation of wetland loss from building the levees.

(4) Significant Adverse Effects on Recreational, Aesthetic, and Economic Resources. Disposal of dredged material would have very little impact on recreational, aesthetic, and economic resources.

h. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on the Aquatic Ecosystem. The formulation of project plans and designs, evaluation of alternative plans, and development of operational scenarios for the tentatively selected plan, have all been conducted with the objective of minimizing potential negative impacts to the aquatic ecosystem. Placement of material excavated for construction of project features was designed in the context best management practices to reduce impacts also mitigation for any loss of functions and values of wetlands are part of the plans.

i. On the Basis of the Guidelines, the Proposed Disposal Sites for the Discharge of Dredged Material are (select one)

X (1) Specified as complying with the requirements of these guidelines; or,

(2) Specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects on the aquatic ecosystem; or,

(3) Specified as failing to comply with the requirements of these guidelines.

IV. Evaluation Responsibility

a. Water Quality Input Prepared by: Rodney Mach and Eric Glisch

b. Project Description and Biological Input Prepared by: Coastal Environmental Planning section - Nathan Dayan

Review Responsibility

a. Water Quality Input reviewed by: Knoll Body
b. Project Description and Biological Input reviewed by: Sandra Stile

______________________	______________________________
Date	Joan M. Exnicios Chief, Environmental Planning Branch

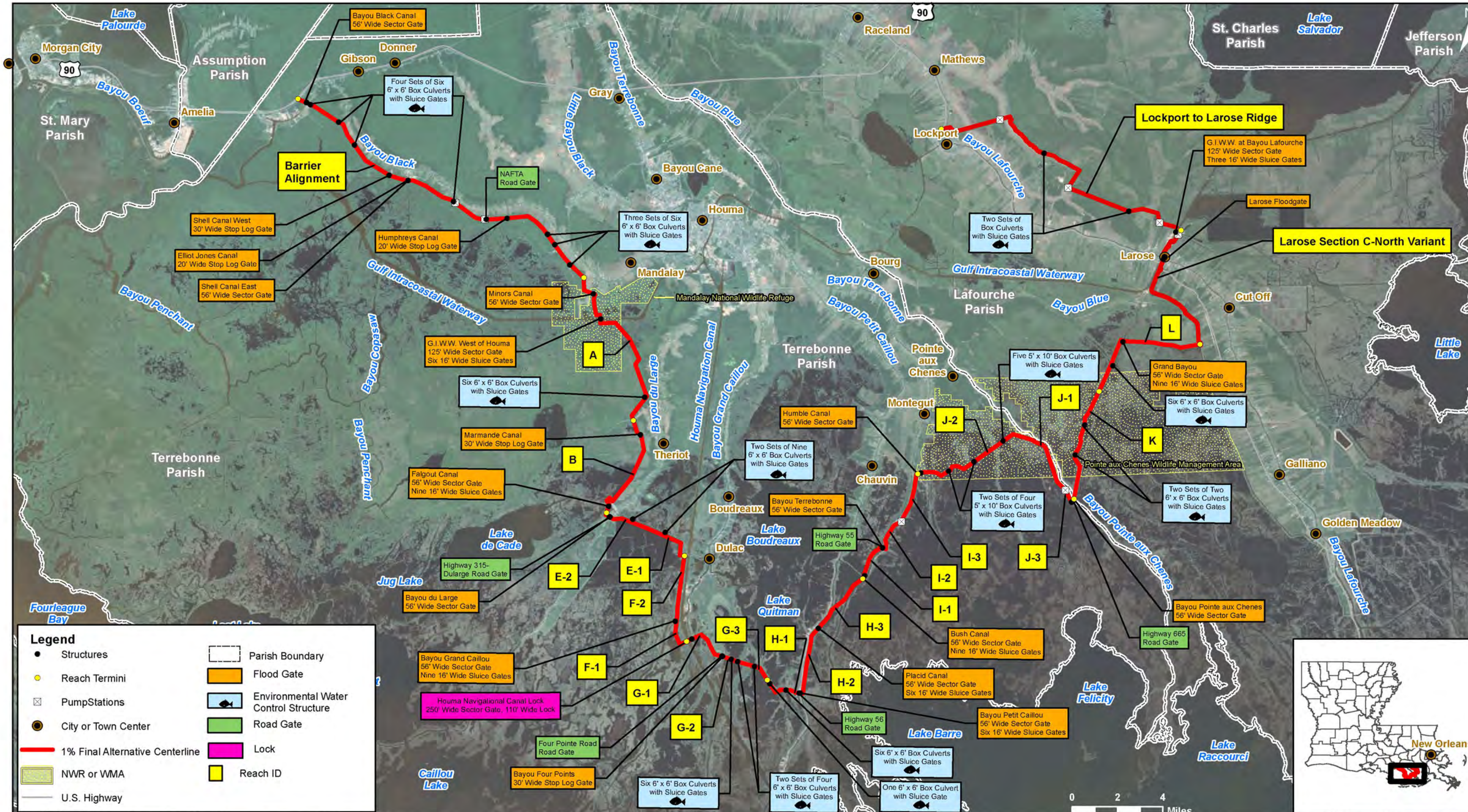


Figure 1. ALIGNMENT AND STRUCTURES OF THE 1% ANNUAL EXCEEDANCE PROBABILITY STORM SURGE RISK REDUCTION SYSTEM ALTERNATIVE

Morganza to the Gulf of Mexico, Louisiana

Revised Programmatic Environmental Impact Statement

Image: I3 USA Prime Imagery

GEC Gulf Engineers & Consultants

Figure: 1	
Date: June 2012	
Scale: 1:256,000	
Source: USACE/GEC	
Map ID: 273160010-2811	

Appendix D

COASTAL ZONE MANAGEMENT PROGRAM CONSISTENCY

CONSISTENCY DETERMINATION

Louisiana Coastal Use Guidelines

Mississippi River and Tributaries
Morganza to the Gulf of Mexico, Louisiana Project

Terrebonne Parish, Louisiana

Revised Programmatic Environmental Impact Statement

INTRODUCTION

Section 307 of the Coastal Zone Management Act of 1972, 16 U.S.C. 1451 et. seq. requires that "each federal agency conducting or supporting activities directly affecting the coastal zone shall conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with approved state management programs." In accordance with Section 307, a Consistency Determination has been prepared for the proposed 1% Annual Exceedance Probability Storm Surge Risk Reduction System. Coastal Use Guidelines were written in order to implement the policies and goals of the Louisiana Coastal Resources Program, and serve as a set of performance standards for evaluating projects. Compliance with the Louisiana Coastal Resources Program, and therefore, Section 307, requires compliance with applicable Coastal Use Guidelines.

PURPOSE AND NEED FOR THE PROPOSED ACTION

The purpose of this project is to provide flood risk reduction for the communities located within the levee system. The goal is to maximize the number of residential and commercial structures protected from damage caused by hurricane storm surges. The project is needed because of the increasing susceptibility of coastal communities to storm surge due to wetland loss, sea level rise, and subsidence. Hurricanes and tropical storm tidal surges have caused immense property damage, human suffering, destruction of natural habitat, and loss of human life in the two-parish study area. While the TLCD is currently maintaining a system of forced drainage levees, pump stations, and flood control structures for Terrebonne Parish, adequate hurricane and storm risk reduction is not currently available for the entire area. This project represents an opportunity to reduce the risk of catastrophic hurricane and tropical storm damages by implementing an effective, comprehensive system for hurricane and flood risk reduction.

DESCRIPTION OF THE PROPOSED ACTION

1% Annual Exceedance Probability Storm Surge Risk Reduction System (1% AEP Alternative) provides risk reduction for water levels that have a 1% chance of occurring each year (see figure). This alternative includes programmatic elements that would be further investigated in the future and constructible elements for which this consistency determination would serve as the required documentation for the Coastal Zone Management Act. The features that have been identified as constructible include, Levee Reach F1 and F2, Levee Reach G1, HNC Lock Complex (HNC Lock), and Bayou Grand Caillou Floodgate (BGC floodgate).

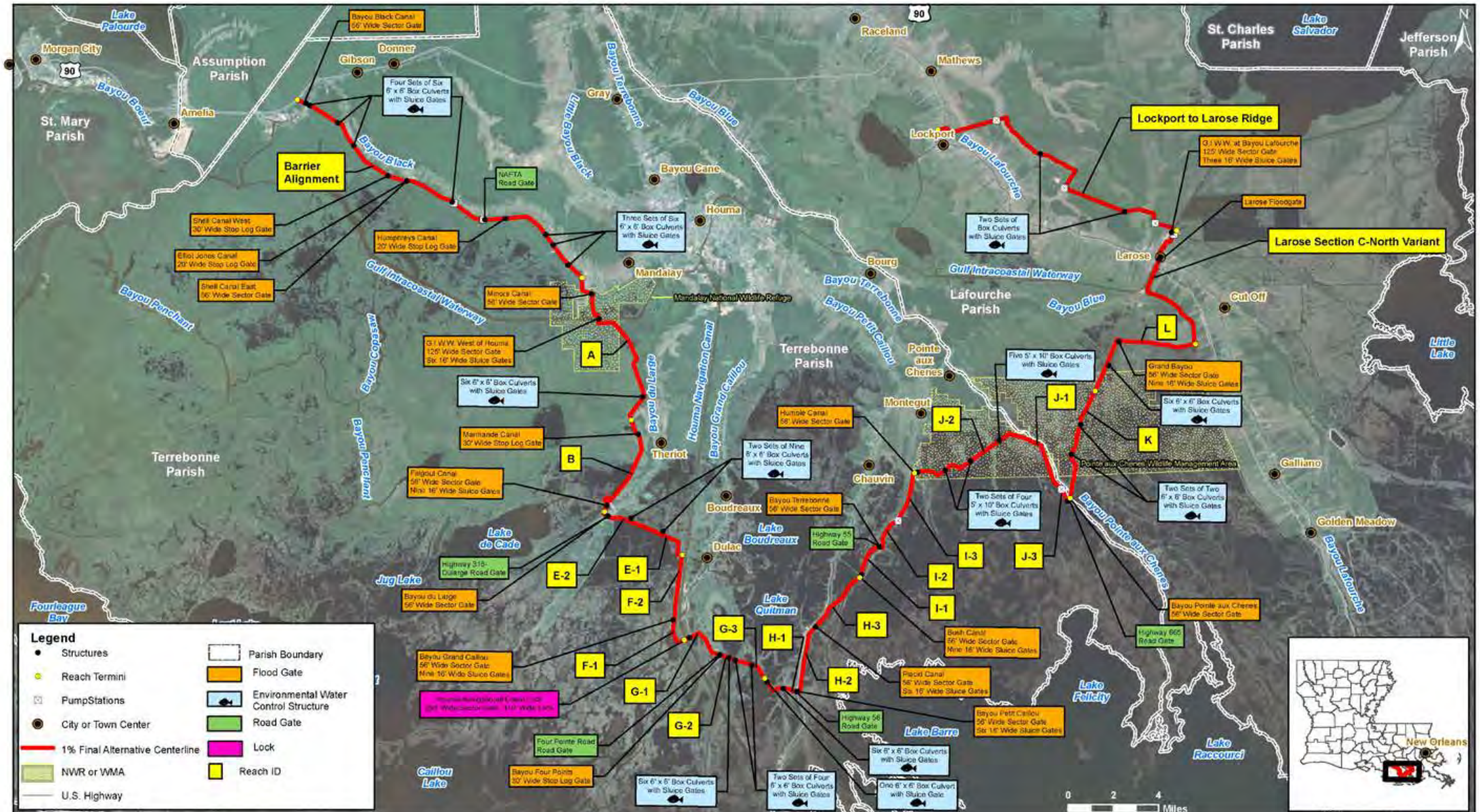


Figure 1. ALIGNMENT AND STRUCTURES OF THE 1% ANNUAL EXCEEDANCE PROBABILITY STORM SURGE RISK REDUCTION SYSTEM ALTERNATIVE

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

Image: I3 USA Prime Imagery

Figure: 1
Date: June 2012
Scale: 1:256,000
Source: USACE/GEC
Map ID: 273160010-2811

The 98-mile levee system would extend from high ground along US 90 near the town of Gibson and tie into Highway 1 near Lockport, LA in Lafourche Parish. Planned levee elevations range from 15.0 to 26.5 feet NAVD88. Toe-to-toe levee widths range from 282 feet to 725 feet. Twenty-two navigable floodgate structures, ranging in elevation from 17.0 to 33 feet (NAVD88), would be located on waterways throughout the levee system, including a lock complex on the HNC. Additionally, environmental water control structures would allow tidal exchange at 23 locations through the levee through sluice gates and box culverts.

Nine road gates would be located at the following levee/road crossings: NAFTA, Four Pointe Road, Highway 315 (DuLarge), Highway 55, Highway 56, Hwy 24, Hwy 3235, Union Pacific RR, and Highway 665. Fronting protection would be provided for four pumping stations, including the Madison, Pointe aux Chenes, Elliot Jones (Bayou Black), and Hanson Canal pump stations.

Levees would be constructed using a combination of sidecast and hauled-in borrow materials. Adjacent side cast was planned for the pre-load section only. Borrow pits are oversized to offset the potential for encountering organics, expected losses, etc. The project would involve constructing 22 navigable floodgates, 23 environmental water control structures, nine road gates, and fronting protection for four existing pumping stations. Structures on Federally maintained navigation channels include the Houma Navigation Canal Lock Complex (and 250-ft sector gate) and two 125-ft sector gates on the GIWW east and west of Houma. In addition, thirteen 56-ft sector gates and five 20- to 30-ft stop log gates are located on various waterways that cross the levee system.

Implementation Schedule	
Activities	**Years for 1% AEP**
Real Estate Acquisition, Utility Relocations, and Mitigation	2014 to 2025
Construction of Structures	2015 to 2024
Construction of Levee Lifts to Achieve Base Year Elevations	2015 to 2035
Construction of Levee Lifts to Achieve Future Year Elevations	2035 to 2071

Acres of Wetlands Directly Effected			
Features	**Tidal Wetlands**	**Force Drained Wetlands**	**Total wetlands**
Constructible Features	644.35	25.98	670.33
Programmatic Features*	3,017	31	3,048
Total Impact	3,661	57	3,718

The constructible features would impact intermediate and brackish marsh, while the programmatic features has the potential to impact bottomland hardwoods, swamp, fresh, intermediate, brackish and saline marsh. Approximate 109 million cubic yards of earthen material (quality based on post-Katrina standards) would be used to build the complete levee alignment to its full height.

GUIDELINES APPLICABLE TO ALL USES

Response to Guidelines 1.1 - 1.6. The guidelines have been read in their entirety and all applicable guidelines would be addressed through the preparation of responses to the guidelines contained within the specific use categories. The proposed action would be in conformance with all applicable state water and air quality laws, regulations, and standards. Therefore, the proposed action is consistent with these guidelines.

Response to Guideline 1.7. This guideline has been read in their entirety and all applicable guidelines would be addressed through the preparation of responses to the guidelines contained within the specific use categories. The constructible features of the proposed action would directly impact approximately 670 acres of wetlands while the programmatic feature could potentially impact approximately 3,520 additional acres. During further studies for the programmatic features there is the potential to reduce the number of acres. There are no adverse effects to guidelines 1.7 a-d, g-k, m-q, and s-u. The impacts to guideline 1.7 e have been avoided to the maximum extent practicable and mitigation for wetland impacts are part of the plan. The impacts to guideline 1.7 f have been avoided to the maximum extent practicable but there is potential for induced damages outside the levee system. In order to prevent increased risk to people and structures, which are already located in high risk areas, a preliminary nonstructural compensation plan has been developed. The impacts to guideline 1.7 l, and r have been avoided to the maximum extent practicable the levee system has been designed with 21 environmental water control structures and 21 navigable structures so that reduction or blockage of water flow is not detrimental to the wetland habitat and species that use that habitat. Therefore, the proposed action is consistent with this guideline.

Responses to Guideline 1.8 – 1.10. The guidelines have been read in their entirety and all applicable guidelines would be addressed through the preparation of responses to the guidelines contained within the specific use categories. The proposed action would be in conformance with all applicable state water and air quality laws, regulations, and standards. Therefore, the proposed action is consistent with these guidelines.

GUIDELINES FOR LEVEES

Responses to Guideline 2.1 and 2.2. The guidelines have been read in their entirety. The impacts to biologically productive wetlands in guideline 2.1 have been avoided to the maximum extent practicable the alignment of the levee system was situated on or next to existing hydraulic barriers (roads, levees, natural ridges, canals) where ever practicable. Additionally the levee system has been designed with 23 environmental water control structures and 22 navigable structures so that reduction or blockage of water flow would be avoid or minimize segmentation of wetland areas. Parts of constructible features, HNC lock, and levee reach G1run across biologically productive wetlands, but have been designed to limit impacts to the maximum extent practicable. Therefore, the proposed action is consistent with these guidelines.

Responses to Guideline 2.3. This guideline has been read in their entirety. The levee construction would not change the use of a wetland area. No additional areas would be put under pump with this proposed action and Jurisdictional standing of the wetlands would not change. Therefore, the proposed action is consistent with this guideline.

Responses to Guideline 2.4. This guideline has been read in their entirety. Part of the Hurricane and flood protection levee is being built on a existing levee and/or is located at the non-wetland/wetland interface or landward to the maximum extent practicable. Parts of constructible features, HNC lock, and levee reach G1run across biologically productive wetlands, but have been designed to limit impacts to the maximum extent practicable. Therefore, the proposed action is consistent with this guideline.

Responses to Guideline 2.5. This guideline has been read in their entirety. There are no impoundment levees as part of the proposed action. Therefore, this guideline is not applicable to the project.

Responses to Guideline 2.6. This guideline has been read in their entirety. The levee system has been designed with 21 environmental water control structures and 21 navigable structures so that reduction or blockage of water flow is limited. These designed used hydraulic models to analyses the potential impacts. . Parts of constructible features, HNC lock, BGC floodgate, and levee reach G1run across biologically productive wetlands, but have been designed to limit impacts to the maximum extent practicable. The levee system would also be built and thereafter operated and maintained utilizing best practical techniques to minimize the existing hydrologic patterns, and the interchange of water, beneficial nutrients and aquatic organisms between enclosed wetlands and those outside the levee system. Therefore, the proposed action is consistent with this guideline.

GUIDELINES FOR LINEAR FACILITIES

Responses to Guideline 3.1 to 3.16. The guidelines have been read in their entirety. This proposed action would not directly include the construction of linear facilities. There would be requirement for the relocation of some linear facilities (pipelines, power lines, etc.), these actions would be covered under either an existing coastal use permit or a modification of this determination depending on if the linear facilities are found to be Federally compensable or not. Therefore, these guidelines are not applicable to the project at this time.

Responses to Guideline 3.1 to 3.3. The guidelines have been read in their entirety. The alignment of the new channel that is part of the HNC Lock Complex would avoid adverse impacts on areas of high biological productivity or irreplaceable resource areas; would avoid wetland and estuarine areas to the maximum extent practicable; and would minimize the width and length. Therefore, the proposed action is consistent with these guidelines.

Responses to Guideline 3.4. This guideline has been read in their entirety. This proposed action would not directly include the construction pipelines. There would be requirement for the relocation of some linear facilities (pipelines, power lines, etc.), these actions would be covered under either an existing coastal use permit or a modification of this determination depending on if the linear facilities are found to be Federally compensable or not. Therefore, this guideline is not applicable to the project at this time.

Responses to Guideline 3.5 and 3.6. The guidelines have been read in their entirety. Existing corridors, rights-of-way, canals, and streams would be utilized to the maximum extent practicable and the alignments would be, to the maximum extent practicable, designed and constructed to permit multiple uses consistent with the nature of the facility for proposed action. Therefore, the proposed action is consistent with these guidelines.

Responses to Guideline 3.7 and 3.8. The guidelines have been read in their entirety. The proposed action involving dredging would not traverse or adversely affect any barrier island, traverse beaches, tidal passes, protective reefs or other natural gulf shoreline. Therefore, these guidelines are not applicable to the project.

Responses to Guideline 3.9 and 3.10. The guidelines have been read in their entirety. The new channel that is part of the HNC Lock Complex would be planned, designed, located and built using the best practical techniques to minimize disruption of natural hydrologic and sediment transport patterns, sheet flow, and water quality, and to minimize adverse impacts on wetlands, to prevent bank slumping and erosion, saltwater intrusion, and to minimize the potential for inland movement of storm-generated surges. The HNC Lock and Flood gate would be built in the new channel and would be used as part of this project to reduce saltwater intrusion. Therefore, the proposed action is consistent with these guidelines.

Responses to Guideline 3.11. This guideline has been read in their entirety. There are no non-navigation canals, channels, and ditches that are part of the proposed alternatives. Therefore, this guideline is not applicable to the project.

Responses to Guideline 3.12. This guideline has been read in their entirety. The multiple use of existing canals, directional drilling and other practical techniques would be utilized to the maximum extent practicable to minimize the number and size of access canals, to minimize changes of natural systems and to minimize adverse impacts on natural areas and wildlife and fisheries habitat. Therefore, the proposed action is consistent with this guideline.

Responses to Guideline 3.13. This guideline has been read in their entirety. This proposed action would not directly include the construction pipelines. There would be requirement for the relocation of some pipelines, power lines, etc., these actions would be constructed in accordance with parts 191, 192, and 195 of Title 49 of the Code of Federal Regulations, as amended, and in conformance with the Commissioner of Conservation's Pipeline Safety Rules and Regulations and those safety requirements established by La. R. S. 45:408, whichever would require higher standards. Therefore, this guideline is not applicable to the project at this time.

Responses to Guideline 3.14 to 3.16. The guidelines have been read in their entirety. Areas dredged for linear facilities would be backfilled or otherwise restored to the pre-existing conditions upon cessation of use for navigation purposes to the maximum extent practicable, the best practical techniques for site restoration and re-vegetation would be utilized for all linear facilities, confined and dead end canals would be avoided to the maximum extent practicable. Approved canals would be designed and constructed using the best practical techniques to avoid water stagnation and eutrophication. Therefore, the proposed action is consistent with these guidelines.

GUIDELINES FOR DREDGED MATERIAL DEPOSITION

Responses to Guideline 4.1. This guideline has been read in their entirety. Adjacent borrow pits have been planned for the pre-load section only of some reaches. For the constructible features dredged material (spoil) would come from the bypass channel and HNC lock area and adjacent borrow pits flood side levee reaches F1 and F2 and the protected side of levee reach G1. Dredged material would be deposited utilizing the best practical techniques to avoid disruption of water movement, flow, circulation, and quality in the creation of the levee system and marsh mitigation areas. Therefore, the proposed action is consistent with this guideline.

Responses to Guideline 4.2. This guideline has been read in their entirety. The top 5 ft of borrow material from adjacent borrow pits is not suitable for levee building because of it organic makeup. Approximately 12,305,000 cubic yards of this organic material would be available for beneficial use to create marsh for the required compensable mitigation. The remaining dredge material from the adjacent pits would be used beneficially to create the levees. No new disposal areas are required. Therefore, the proposed action is consistent with this guideline.

Responses to Guideline 4.3. This guideline has been read in their entirety. The levee construction would not be disposed of in a manner which could result in the impounding or draining of wetlands or the creation of development sites no additional areas would be put under pump with this proposed action and Jurisdictional standing of the wetlands would not change. Therefore, the proposed action is consistent with this guideline.

Responses to Guideline 4.4. This guideline has been read in their entirety. The levee alignment and width has been designed to reduce the deposition of dredge material on marsh and submersed vegetation to the maximum extent practicable. There are no direct depositions on known oyster or clam reefs. Therefore, the proposed action is consistent with this guideline.

Responses to Guideline 4.5 to 4.7. The guidelines have been read in their entirety. No dredged material would be disposed of in such a manner as to create a hindrance to navigation or fishing, or hinder timber growth, disposal areas would be designed and constructed and maintained using the best practical techniques to retain the material at the site, reduce turbidity, and reduce shoreline erosion when appropriate, and no state-owned property would be alienated due result from dredge material deposition activities without the consent of the Department of Natural Resources. Therefore, the proposed action is consistent with these guidelines.

GUIDELINES FOR SHORELINE MODIFICATION

Responses to Guideline 5. 5 and 5.6. The guidelines have been read in their entirety. Under the constructible features there would be shoreline modification as part of the HNC Lock complex. Non-structural methods of shoreline protection would be utilized to the maximum extent practicable, s shoreline modification structures would be designed and built using best practical techniques to minimize adverse environmental impacts, would be lighted or marked in accordance with U.S. Coast Guard regulations, not interfere with navigation, and should foster fishing, other recreational opportunities, and public access, and would be built using best practical materials and techniques to avoid the introduction of pollutants and toxic substances into coastal waters. Therefore, the proposed action is consistent with these guidelines.

Responses to Guideline 5.5 and 5.6. The guidelines have been read in their entirety. There are no piers and docks and other harbor structures or Marinas being built as part of the proposed action. Therefore, these guidelines are not applicable to the project.

Responses to Guideline 5.7. This guideline has been read in their entirety. Neglected or abandoned shoreline modification structures, piers, docks, mooring and other harbor structures would be removed at the owner's expense, when appropriate. Therefore, the proposed action is consistent with this guideline.

Responses to Guideline 5.8. This guideline has been read in their entirety. Shoreline stabilization structures are being built for the purpose of creating fill areas as part of the HNC Lock complex a public works project covered under Guideline 6.2 of the Guideline for Surface Alterations below. Therefore, the proposed action is consistent with this guideline.

<u>Responses to Guideline 5.9</u>. This guideline has been read in their entirety. There are no jetties, groins, breakwaters, and similar structures being built as part of the proposed action. Therefore, this guideline are not applicable to the project.

GUIDELINES FOR SURFACE ALTERATIONS

<u>Responses to Guideline 6.1</u>. This guideline has been read in their entirety. The proposed action would not add any new industrial, commercial, urban, residential, and recreational uses. Therefore, the proposed action is consistent with this guideline.

<u>Responses to Guideline 6.2</u>. This guideline has been read in their entirety. The proposed levee systems protects areas suitable for development pursuant to Guideline 6.1, are consistent with the other guideline and are consistent with all relevant adopted state, local and regional plans.

<u>Responses to Guideline 6.3</u>. BLANK (Deleted)

<u>Responses to Guideline 6.4</u>. This guideline has been read in their entirety. The levee alignment and width has been designed to reduce the deposition of dredge material in wetlands. Dredged material would be deposited utilizing the best practical techniques to minimize present and future property damage and adverse environmental impacts. Compensatory mitigation for the value of the wetlands is part of the proposed action. Therefore, the proposed action is consistent with these guideline.

<u>Responses to Guideline 6.5</u>. This guideline has been read in their entirety. This proposed action would not include Coastal water dependent uses. Therefore, this guideline is not applicable to the project.

<u>Responses to Guideline 6.6 and 6.7</u>. The guidelines have been read in their entirety. Areas modified by surface alteration activities (temporary access roads, staging area, etc.) would to the maximum extent practicable, be re-vegetated, refilled, cleaned, and restored to their predevelopment condition upon termination of the use as part of the proposed action. Site clearing would to the maximum extent practicable be limited to those areas immediately required for physical development as part of the proposed action. Therefore, the proposed action is consistent with these guidelines.

<u>Responses to Guideline 6.8</u>. This guideline has been read in their entirety. Surface alterations would, to the maximum extent practicable, be located away from critical wildlife areas and vegetation areas. Coordination has occurred and would continue with US Fish and Wildlife service and Louisiana Department of Fish and Wildlife concerning construction in the Mandalay National Wildlife Refuge and Pointe Aux Chenes Wildlife Management Area. Therefore, the proposed action is consistent with this guideline.

<u>Responses to Guideline 6.9</u>. This guideline has been read in their entirety. There are no planned surface alterations which have high adverse impacts on natural functions on barrier islands and beaches, isolated cheniers, isolated natural ridges or levees, or in wildlife and aquatic species breeding or spawning areas, or in important migratory routes. Therefore, the proposed action is consistent with this guideline.

Responses to Guideline 6.10. This guideline has been read in their entirety. The proposed action does not create low dissolved oxygen conditions in the water or traps for heavy metals. Therefore, this guideline is not applicable to the project.

Responses to Guideline 6.11 This guideline has been read in their entirety. The surface mining that is part of the proposed action would be carried out utilizing the best practical techniques to minimize adverse environmental impacts. Offsite borrow locations would be located in not wetland areas and would be covered in future modification request for the programmatic features. Therefore, the proposed action is consistent with this guideline.

Responses to Guideline 6.12. This guideline has been read in their entirety. The proposed action would not create underwater obstructions. Therefore, this guideline is not applicable to the project.

Responses to Guideline 6.12. This guideline has been read in their entirety. Surface alteration sites that are part of the proposed action would be designed, constructed, and operated using the best practical techniques to prevent the release of pollutants or toxic substances into the environment and minimize other adverse impacts. Therefore, the proposed action is consistent with this guideline.

Responses to Guideline 6.12. This guideline has been read in their entirety. The proposed action would use material that is free of contaminants and compatible with the environmental setting as fill. Therefore, the proposed action is consistent with this guideline.

GUIDELINES FOR HYDROLOGIC AND SEDIMENT TRANSPORT MODIFICATIONS

Responses to Guideline 7.1 to 7.4. The guidelines have been read in their entirety. There are no planned controlled diversion of sediment-laden waters, sediment deposition system, siphons, and controlled conduits in the proposed alternative. Therefore, these guidelines are not applicable to the project.

Responses to Guideline 7.5 to 7.7. The guidelines have been read in their entirety. The levee system has been designed with 21 environmental water control structures and 21 navigable structures so that reduction or blockage of water flow would be avoid. The constructible features (HNC Lock and Floodgate and BGC Floodgate) and the associated water management plans would result in an overall benefit to the productivity of the area due to the use of the lock to limit saltwater intrusion based on system wide and structure specific hydraulics models. All of the water control structures were modeled as part of the system wide model. As the programmatic features are designed future assessments of their merits would be done. Weirs and similar water control structures would be designed and built using the best practical techniques to prevent "cut arounds," permit tidal exchange in tidal areas, and minimize obstruction of the migration of aquatic organisms. Therefore, the proposed action is consistent with these guidelines.

Responses to Guideline 7.8. This guideline has been read in their entirety. The levee system has been designed with 21 environmental water control structures and 21 navigable structures to limit impoundments which prevent normal tidal exchange and/or the migration of aquatic organisms would not be constructed in brackish and saline areas to the maximum extent practicable. Therefore, the proposed action is consistent with this guideline.

Responses to Guideline 7.8. This guideline has been read in their entirety. There is no withdrawal of surface and ground water as part of the proposed alternative. Therefore, this guideline is not applicable to the project.

GUIDELINES FOR DISPOSAL OF WASTES

Responses to Guideline 8.1 to 8.9 .The guidelines have been read in their entirety. The proposed action would not involve the disposal of wastes and, therefore, these guidelines are not applicable.

GUIDELINES FOR USES THAT RESULT IN THE ALTERATION OF WATERS DRAINING INTO COASTAL WATERS

Responses to Guideline 9.1 to 9.3. The guidelines have been read in their entirety. The proposed action would not involve the alteration of waters draining into coastal waters and, therefore, these guidelines are not applicable.

GUIDELINES FOR OIL, GAS, AND OTHER MINERAL ACTIVITIES

Responses to Guideline 10.1 to 10.19 The guidelines have been read in their entirety. The proposed action would not involve oil, gas, and other mineral activities and, therefore, these guidelines are not applicable.

OTHER STATE POLICIES INCORPORATED INTO THE PROGRAM

Section 213.8A of Act 361 directs the Secretary of DOTD, in developing the LCRP, to include all applicable legal and management provisions that affect the coastal zone or are necessary to achieve the purposes of Act 361 or to implement the guidelines effectively. It states:

The Secretary shall develop the overall state coastal management program consisting of all applicable constitutional provisions, laws and regulations of this state which affect the coastal zone in accordance with the provisions of this Part and shall include within the program such other applicable constitutional or statutory provisions, or other regulatory or management programs or activities as may be necessary to achieve the purposes of this Part or necessary to implement the guidelines hereinafter set forth.

The constitutional provisions and other statutory provisions, regulations, and management and regulatory programs incorporated into the LCRP are identified and described in Appendix 1. A description of how these other authorities are integrated into the LCRP and coordinated during program implementation is presented in Chapter IV. Since all of these policies are incorporated into the LCRP, federal agencies must ensure that their proposed actions are consistent with these policies as well as the coastal use guidelines. (CZMA, Section 307)

CONSISTENCY DETERMINATION

The proposed action is consistent with the guidelines for all uses, levees, linear facilities, dredged material deposition, shoreline modification, surface alterations, and hydrologic and sediment transport. Based on this evaluation, the U. S. Army Corps of Engineers, New Orleans District, has determined that the proposed is consistent, to the maximum extent practicable, with the State of Louisiana's Coastal Resources Program.

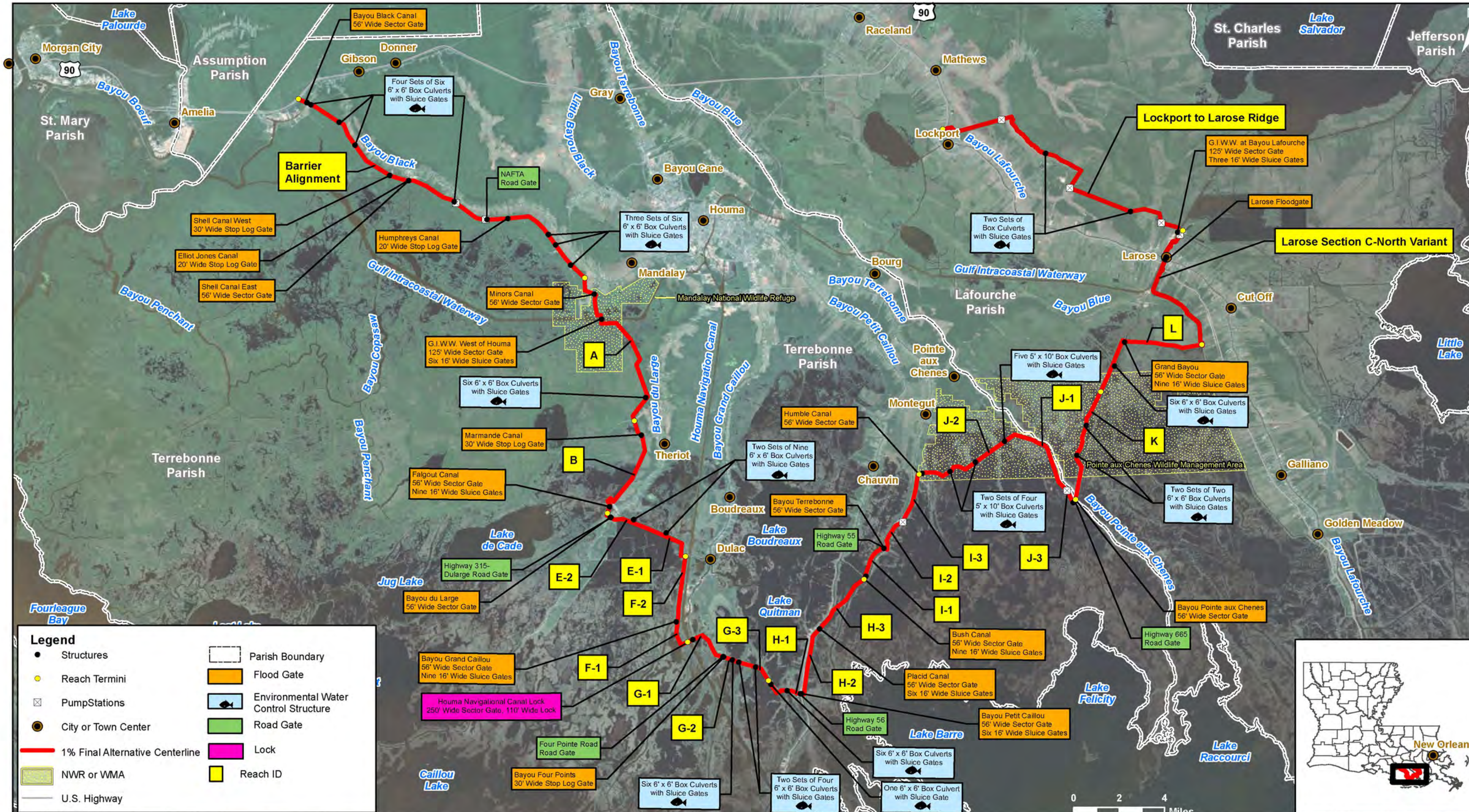


Figure 1. ALIGNMENT AND STRUCTURES OF THE 1% ANNUAL EXCEEDANCE PROBABILITY STORM SURGE RISK REDUCTION SYSTEM ALTERNATIVE

Morganza to the Gulf of Mexico, Louisiana

Revised Programmatic Environmental Impact Statement

Image: I3 USA Prime Imagery

GEC Gulf Engineers & Consultants

Figure: 1

Date: June 2012

Scale: 1:256,000

Source: USACE/GEC

Map ID: 273160010-2811

Appendix E

PUBLIC COMMENTS

To Be Included in Later Submittal

Appendix F

WETLAND VALUE ASSESSMENT

Appendix F

WETLAND VALUE ASSESSMENT

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

REPLY TO
ATTENTION OF

CECW-P 8 November 2011

MEMORANDUM FOR Director, National Ecosystem Restoration Planning Center of Expertise (ECO-PCX)

SUBJECT: Wetland Value Assessment (WVA) Models – Barrier Headland, Barrier Island, Bottomland Hardwood, Coastal Chenier, and Swamp Models - Model Approval.

1. The HQUSACE Model Certification Panel has reviewed the externally-developed WVA in accordance with EC 1105-2-412 and has determined that the Barrier Headland, Barrier Island, Bottomland Hardwood, Coastal Chenier, and Swamp Models and their accompanying documentation are sufficient to approve the models for regional use. The WVA models were developed by the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Environmental Work Group, an interagency team including US Fish and Wildlife Service, National Marine Fisheries Services, US Environmental Protection Agency, Natural Resources Conservation Service, USACE, and Louisiana Office of Coastal Protection and Restoration.

2. The models were initially developed in the 1990s and have been periodically revised and updated by the CWPPRA Environmental Work Group which is led by the US Fish and Wildlife Service. Models developed by non-Federal government entities, NGOs, or academic institutions which are proposed as part of a Corps planning study can be approved for use based on an assessment of the proponent's documentation demonstrating that the model satisfies the certification criteria.

3. Battelle Memorial Institute conducted an independent review of the procedural manual, community models and associated spreadsheets to assess the technical quality and usability of the model. A number of high significance concerns with the documentation of the model were raised. Further coordination with the ECO-PCX clarified that the ECO-PCX had conducted a detailed review of the model documentation and model spreadsheets to evaluate the degree to which revisions were made based on the model review comments and responses. Adequate technical reviews have been accomplished. This approval is based on the decision of the HQUSACE Model Certification Panel which considered the ECO-PCX assessments of the models.

APPLICABILITY: This approval for use is limited to applicable projects in coastal Louisiana and eastern Texas..

Harry E. Kitch

HARRY E. KITCH, P.E.
Deputy Chief, Planning and Policy Division
Directorate of Civil Works

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

REPLY TO
ATTENTION OF

CECW-P

28 February 2012

MEMORANDUM FOR Director, National Ecosystem Restoration Planning Center of Expertise (ECO-PCX)

SUBJECT: Wetland Value Assessment Models – Coastal Marsh Module Version 1.0 – Approval for Use

1. The Coastal Marsh Community model is one of seven WVA community models that were developed by the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Environmental Work Group. Based on information provided by the ECO-PCX, it is the understanding of the HQUSACE Model Certification Panel that this model will be used on the following projects over the next five years:

a. MRGO Ecosystem Restoration
b. Barataria Basin Barrier Shoreline
c. Lake Pontchatrain and Vicinity Hurricane Storm Damage Risk Reduction System (HSDRRS) Mitigation
d. West Bank and Vicinity HSDRRS Mitigation
e. HSDRRS IERS –total number unknown
f. Louisiana Coastal Area (LCA) 4 Davis Pond Modification
g. LCA4 Modification to Caernarvon
h. LCA4 Point Au Fer Island
i. LCA4 Caillou Lake Land Bridge
j. LCA Myrtle Grove
k. LCA White Ditch PED
l. LCA Mississippi River Hydrodynamic and Delta Management
m. LCA Caernarvon
n. Larose to Golden Meadow (LGM) Post-Authorization Change (PAC) Study
o. Larose to Golden Meadow Intracoastal Floodwall Reach 2b (LGM-022C).
p. Larose to Golden Meadow Intracoastal Floodwall Reach 2a (LGM-022B).
q. Larose to Golden Meadow C-North Highway 24 Relocation (LGM-001C).
r. Baptiste Collette Bayou Deepening study
s. Barataria Bay Waterway (CAP 204)
t. Buras Marina (CAP 206)
u. Calcasieu River and Pass (CAP 204)
v. Calcasieu Lock Replacement
w. Morganza to the Gulf PAC
x. Morganza to the Gulf Supplemental NEPA documents –total number unknown
y. Southwest Coastal
z. Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) – West Bay Closure
aa. Houma Navigation Canal Deepening
bb. West Shore Lake Pontchartrain Hurricane & Flood Risk Reduction
cc. LCA Terrebonne Basin Barrier Shoreline Restoration
dd. LCA Demonstration Projects Grand Isle and Vicinity Project
ee. CAP 103 Grand Isle Highway 1 Shoreline Stabilization
ff. Donalsonville to the Gulf
gg. NOV Plaquemines Parish
hh. NFL Plaquemines Parish

2. Version 1.0 of the Coastal Marsh Community model is approved for use for the above projects. This approval for use is based on the decision of the HQUSACE Model Certification Panel which considered the ECO-PCX assessment of the model. Adequate technical reviews have been accomplished and the model meets the certification criteria contained in EC 1105-2-412. As indicated by the ECO-PCX, there are a number of unresolved issues related to the form of suitability graphs for Variables 1, 2 and 3 and the aggregation methods used to combine the marsh habitat units and open water habitat units for each sub-model. To increase the understanding of the sensitivity of the model to the unresolved issues and the impact the model differences may have on decision-making, the ECO-PCX is to work with the project delivery teams to conduct sensitivity analyses for each application of the marsh models. A summary of the sensitivity analyses must be presented in the project documentation and Agency Technical Review teams must be charged with reviewing the adequacy and findings of the sensitivity analyses.

3. It is expected that compiliation of the findings of the multiple sensitivity analyses will lead to updates and improvements of the model. As such, version control is imperative. The PCX must ensure that project delivery teams are are utilizing the most appropriate version of the model for their analyses and that they are properly identifiying the version of the model being used.

APPLICABILITY: This approval for use expires 28 February 2017 and is limited to the above studies with the caveat that updated versions of the model be used if appropriate.

Harry E. Kitch

HARRY E. KITCH, P.E.
Deputy Chief, Planning and Policy Division
Directorate of Civil Works

DEPARTMENT OF THE ARMY
MISSISSIPPI VALLEY DIVISION, CORPS OF ENGINEERS
P.O. BOX 80
VICKSBURG, MISSISSIPPI 39181-0080

REPLY TO
ATTENTION OF:

CEMVD-PD-N 12 March 2012

MEMORAMDUM FOR CECW-PC (Wes Coleman)

SUBJECT: Wetland Value Assessment Models – Marsh Model, Recommendation for Single Use Approval on Multiple Projects

1. References

a. Engineering Circular 1105-2-412: Assuring Quality of Planning Models, dated 31 March 2011.

b. CEMVN Memorandum Subject: Wetland Value Assessment Models – Marsh Model, Summary of Model Review Results and Recommendation for Interim Approval, dated 6 February 2012.

2. The National Ecosystem Planning Center of Expertise (ECO-PCX) recommended approval of the Wetland Value Assessment (WVA) Coastal Marsh Community Models 1.0 for in Reference a. The Headquarters Model Certification Team discussed the Coastal Marsh Community model on 14 February 2012 and requested a list of projects that plan to use the model over the next 5 years. Below is a list of projects that plan to use the Coastal Marsh Model.

a. MRGO Ecosystem Restoration
b. Barataria Basin Barrier Shoreline
c. Lake Pontchatrain and Vicinity Hurricane Storm Damage Risk Reduction System (HSDRRS) Mitigation
d. West Bank and Vicinity HSDRRS Mitigation
e. HSDRRS IERS – multiple total number unknown
f. Louisiana Coastal Area (LCA)4 Davis Pond Modification
g. LCA4 Modification to Caernarvon
h. LCA4 Point Au Fer Island
i. LCA4 Caillou Lake Land Bridge
j. LCA Myrtle Grove
k. LCA White Ditch PED
l. LCA Mississippi River Hydrodynamic and Delta Management
m. LCA Caernarvon
n. Larose to Golden Meadow (LGM) Post-Authorization Change (PAC) Study and SEIS
o. Larose to Golden Meadow Intracoastal Floodwall Reach 2b (LGM-022C).
p. Larose to Golden Meadow Intracoastal Floodwall Reach 2a (LGM-022B).
q. Larose to Golden Meadow C-North Highway 24 Relocation (LGM-001C).
r. Baptiste Collette Bayou Deepening study (Conducted by local interests under WRDA 86, Section 203)

s. Barataria Bay Waterway (CAP 204)
t. Buras Marina (CAP 206)
u. Calcasieu River and Pass (CAP 204)
v. Calcasieu Lock Replacement
w. Morganza to the Gulf PAC
x. Morganza to the Gulf Supplemental NEPA documents – multiple total number unknown
y. Southwest Coastal
z. Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) – West Bay Closure
aa. Houma Navigation Canal Deepening
bb. West Shore Lake Pontchartrain Hurricane & Flood Risk Reduction
cc. LCA Terrebonne Basin Barrier Shoreline Restoration
dd. LCA Demonstration Projects Grand Isle and Vicinity Project
ee. CAP 103 Grand Isle Highway 1 Shoreline Stabilization
ff. Donalsonville to the Gulf
gg. NOV Plaquemines Parish
hh. NFL Plaquemines Parish

9. The ECO-PCX recommends a single use approval of the Wetland Value Assessment Coastal Marsh Community Model 1.0 on the projects listed above.

Jodi K. Creswell
Jodi K. Creswell
Operational Director, Ecosystem Restoration
Planning Center of Expertise

CF:
CECW-PC (Matusiak)
CECW-CP (Kitch, Hughes)
CECW-PB (Carlson)
CECW-MVD (Redican, Lucyshyn, Marlowe)
CEMVN-PD (Constance, Young)
CEMVD-PD-N (Wilbanks, Smith, Ruff, Chewning, Kleiss, Creswell, Vigh)
CEMVN-PD-P (Miller)
CEMVN-PDN (Exnicios)
CEMVN- PDN-CEP (Stiles, Klein, Dayan, Behrens)
CEMVN-PM-OR (Bosenberg)
CEERD-EE-E (Fischenich)

Methodology for Quantifying Environmental Benefits/Impacts

The study area was divided into subunits or polygons having similar wetland loss characteristics and loss rates (Figure 1).

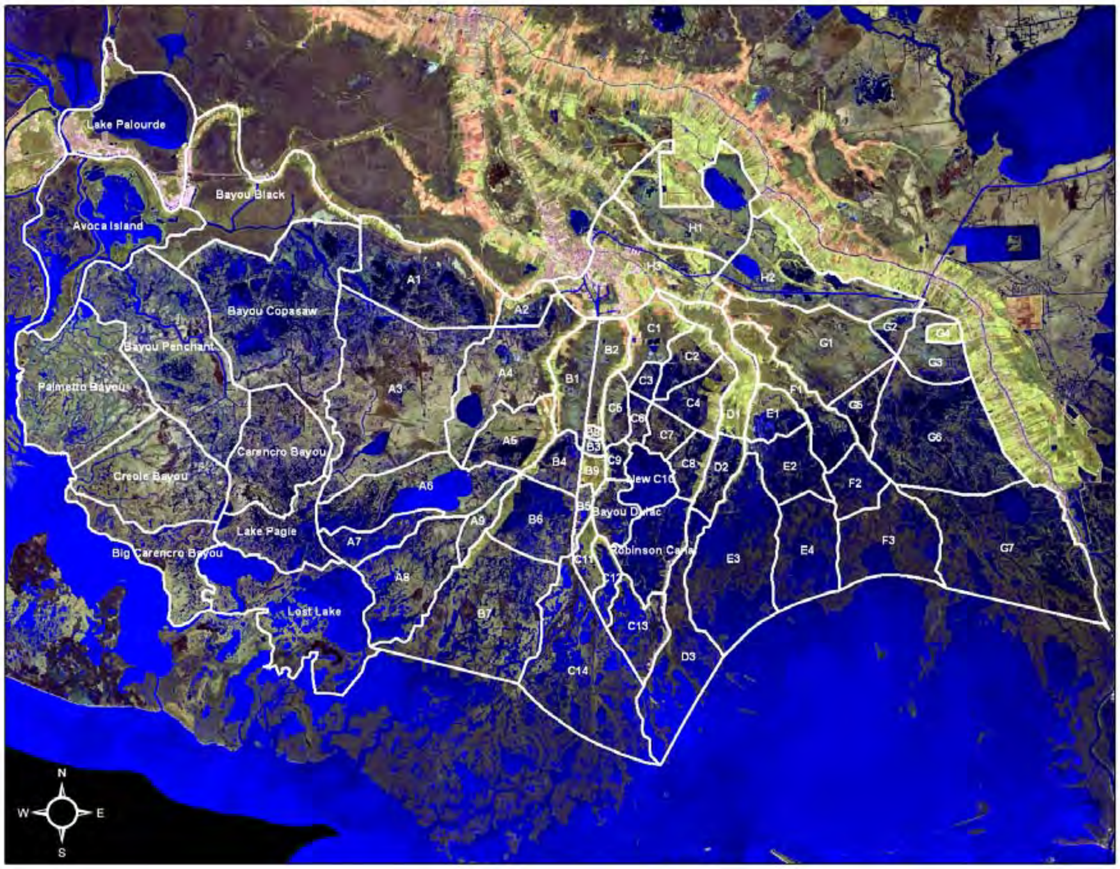


Figure 1. Map delineating study area subunits.

Wetland acreage data (1985 through 2008) was obtained from the USGS from satellite imagery for each of the study area subunits. Future-without-project (FWOP) subunit wetland acreages and marsh loss rates were determined by producing a linear trendline through the data (Figure 2) for each study area subunit. Using the trendline, marsh acreages within each study area subunit were projected from 1985 through the project life (2035 to 2085). This process applies only to coastal marshes. The conversion of forested habitats to open water or other habitat types is a much more complicated process and no simple methods are currently available to predict such habitat type changes.

The trendline projections are assumed to represent a continuation of the historic low sea level rise (SLR) scenario. However, future acreages were also calculated for two additional scenarios characterized by increasing SLR.

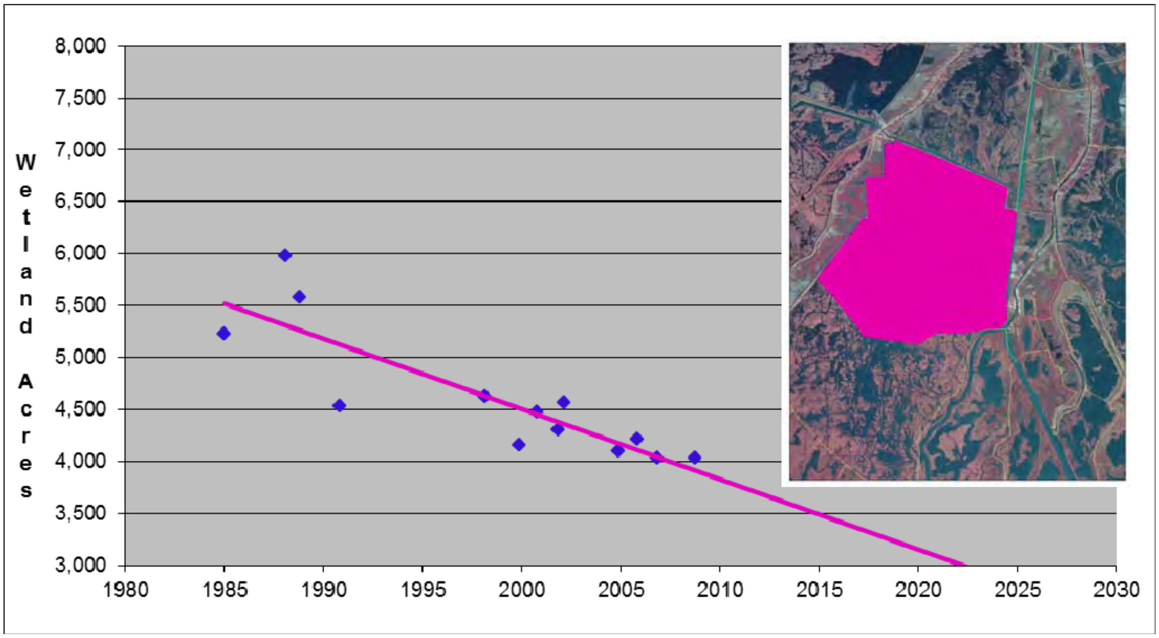


Figure 2. Observed data points and linear trendline for marshes of subunit B13.

Long-term water level gage data from the Leeville, Louisiana gage was utilized per the Corps' Engineering Circular (EC) 1165-2-212 to develop relative sea level rise associated with low (historic), intermediate, and high sea level rise estimates. According to EC guidance, the intermediate and high estimates of eustatic SLR were derived using the National Research Council (NRC) equations NRC I and NRC III, respectively. Based on the Leeville gage, the historic water level rise trend has been 6.995 mm/yr. Subtracting the historic eustatic SLR rate of 1.7 mm/yr yields a subsidence rate of 5.295 mm/yr. By adding the subsidence rate to the eustatic SLR rates associated with each SLR scenario, RSLR rates were determined for those three SLR scenarios (Figure 3).

Recent wetland loss rates (1985-2008) were assumed to have occurred under a constant low SLR rate. Therefore, for the low RSLR scenario (i.e., the continuation of the current 6.995 mm per year RSLR rate observed at the Leeville gage), the historic marsh loss rates were held constant and projected forward to provide yearly land acreages through the life of the project. For the intermediate and high scenarios, the 1985-2008 annual wetland loss rates for each subunit were gradually increased (beginning in 2010), by adding an additional annual increment of loss based on the SLR increase for that year. Those annual wetland loss rate increases were based on the slope of the negative relationship observed between wetland loss rates and RSLR rates from coastwide non-fresh marshes outside of active deltaic influences. In this relationship, RSLR was calculated as the sum of subsidence per statewide subsidence zones (see Figure 4) plus a eustatic SLR rate of 1.7

mm/yr. Recent land loss rates in percent per year were plotted against RSLR determined for those subsidence zones (Figure 5).

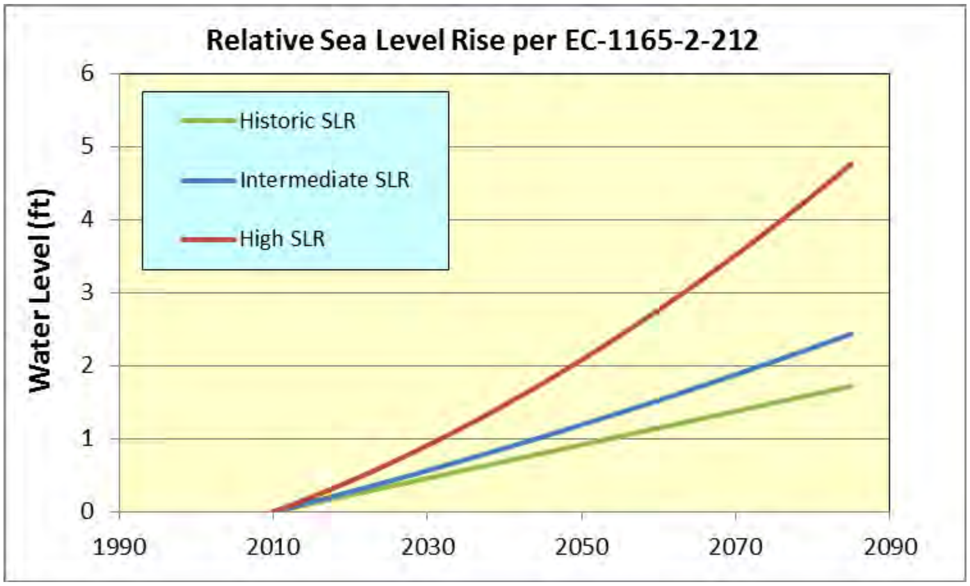


Figure 3. RSLR estimates determined using EC 1165-2-212.

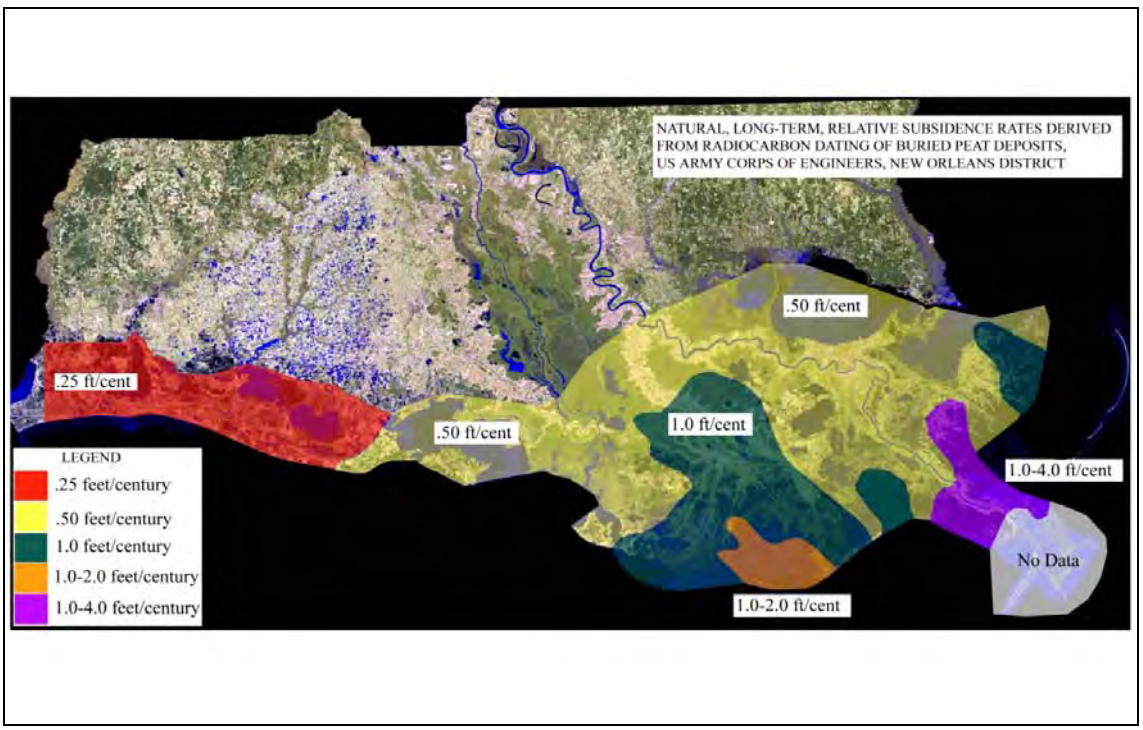


Figure 4. Coastwide subsidence zones from the Corps of Engineers.

According to the slope of this wetland loss vs RSLR relationship, every 1.0 mm/yr increase in RSLR would result in a 0.11%/yr increase in the wetland loss rate. The additional RSLR related wetland loss rate was then added to the baseline or historic loss rate to obtain total annual loss rates for each year, under the increasing sea level rise scenarios.

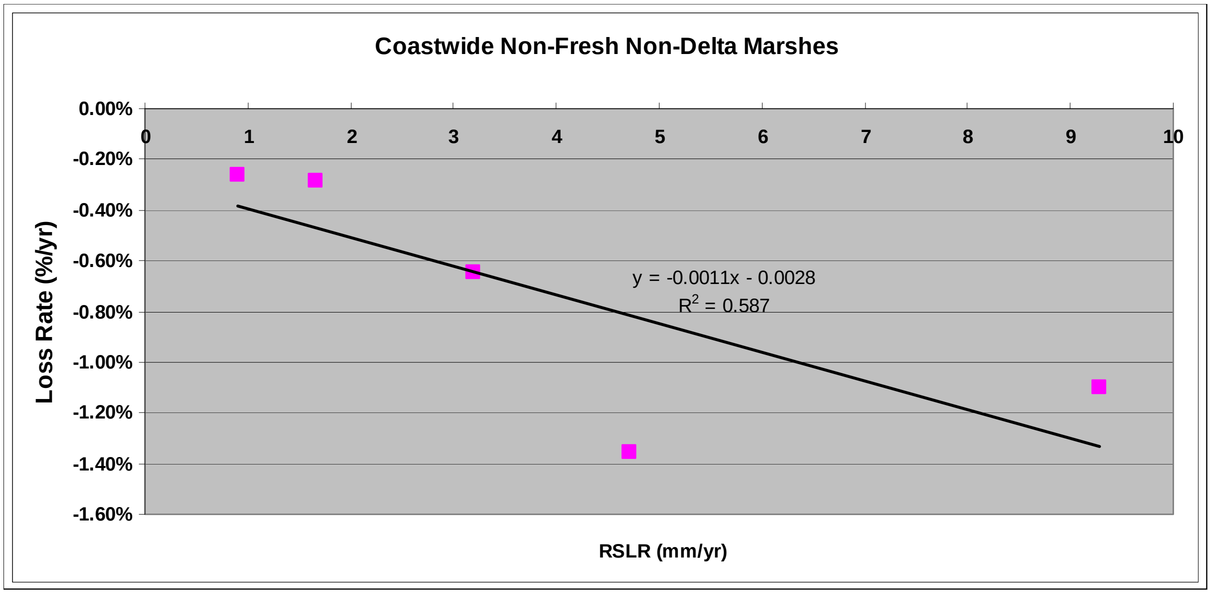


Figure 5. Coastwide wetland loss rates vs. RSLR relationship.

To determine the acreage of construction impacts in the year construction begins, National Wetland Inventory (NWI) 2008 data for the study area were obtained. Using ArcMap software, that NWI data was subdivided by each levee alternative right-of-way footprint, by individual levee reach, and by the study area loss polygons (Figure 6). The resulting data set provided acres of direct impacts in 2008, by habitat type, by levee alternative, levee reach, and loss polygon. Because of wetland loss, wetland loss rates from study area subunits, had to be applied to the 2008 NWI marsh acreages to obtain estimates of construction impacts in the year during which construction would occur.

Given the tight study schedule, the Habitat Evaluation Team (HET) agreed that the for levee segments not seeking immediate construction authorization, a tabulation of impacted habitat type acres would be sufficient for a programmatic evaluation.
However, it is desired that a detailed evaluation of levee reaches F1, F2, G1, the HNC Lock Complex and the Bayou Grand Caillou should be conducted so that those project features could be ready for authorization and construction. Accordingly, the HET decided that those features should be evaluated using the Wetland Value Assessment (WVA v1.1) methodology to assess project impacts to both habitat quantity and quality over time.

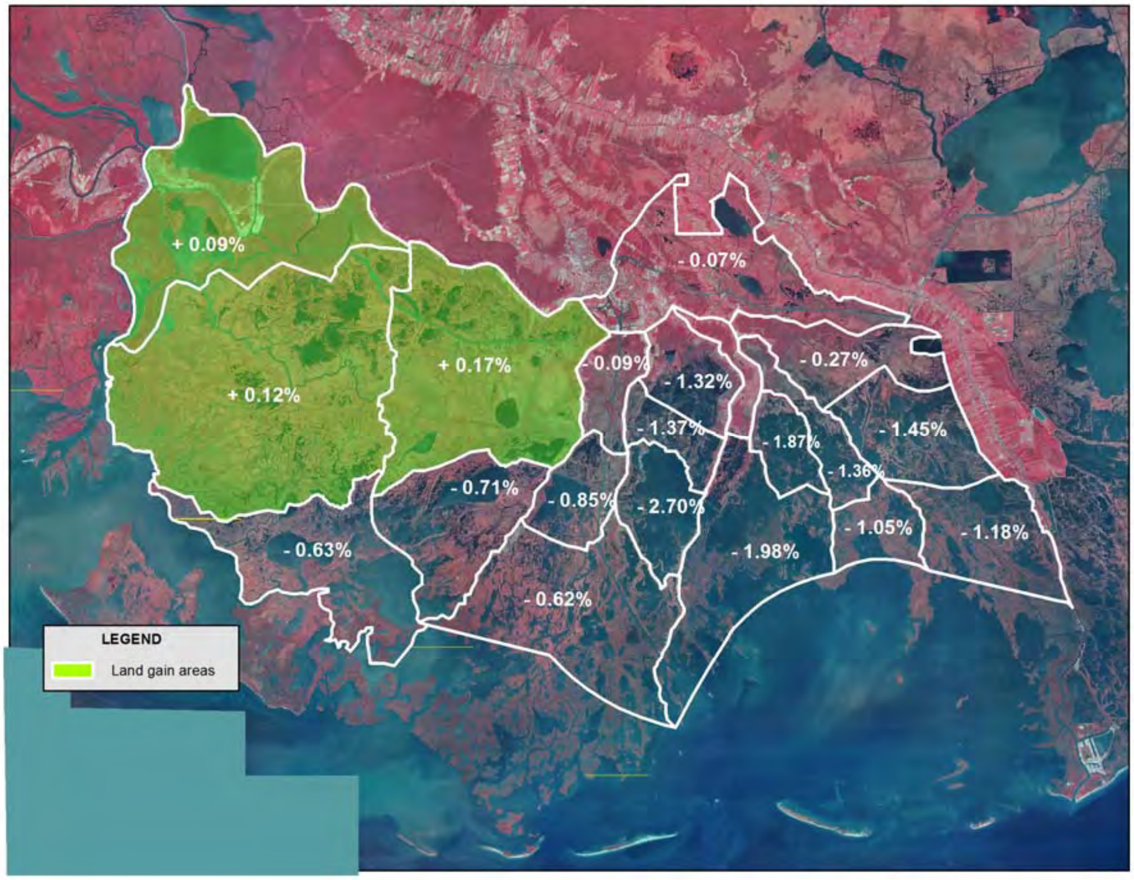


Figure 6. Land Loss Rates for each Study Area Subunit

WVA Methodology

The Wetland Value Assessment (WVA) methodology was initially developed to evaluate proposed Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) projects (LCWCRTF 2006b). The WVA methodology is similar to the Service's Habitat Evaluation Procedures (HEP), in that habitat quality and quantity are measured for baseline conditions and predicted for FWOP and FWP conditions. The Fresh/Intermediate Marsh Model and the Brackish Marsh Model were used for this project. Instead of the species-based approach of HEP, the WVA models use an assemblage of variables considered important to the suitability of a given habitat type for supporting a diversity of fish and wildlife species. As with HEP, the WVA allows a numeric comparison of each future condition and provides a combined quantitative and qualitative estimate of project-related impacts to fish and wildlife resources.

WVA models operate under the assumption that optimal conditions for fish and wildlife habitat within a given coastal wetland type can be characterized, and that existing or predicted conditions can be compared to that optimum to provide an index of habitat quality. Habitat quality is estimated and expressed through the use of a mathematical model developed specifically for each habitat type. Each model consists of: 1) a list of variables that are considered important in characterizing fish and wildlife habitat; 2) a Suitability Index graph for each variable, which defines the assumed relationship between habitat quality (Suitability Indices) and different variable values; and 3) a mathematical formula that combines the Suitability Indices for each variable into a single value for wetland habitat quality, termed the Habitat Suitability Index (HSI).

Emergent marsh habitat models have been developed for fresh, intermediate, brackish and saline marsh types. The habitat variable-habitat suitability relationships within those WVA models have not been verified by field experiments or validated through a rigorous scientific process. However, the variables were originally derived from HEP suitability indices taken from species models for species found in that habitat type. It should also be noted that some aspects of the WVA have been defined by policy and/or functional considerations of CWPPRA. However, habitat variable-habitat suitability relationships are, in most cases, supported by scientific literature and research findings. In other cases, best professional judgment by a team of fisheries biologists, wildlife biologists, ecologists, and university scientists may have been used to determine certain habitat variable-habitat suitability relationships. In addition, the WVA models have undergone a refinement process and habitat variable-habitat suitability relationships, HSIs, and other model aspects are periodically modified as more information becomes available regarding coastal fish and wildlife habitat suitability, coastal processes, and the efficacy of restoration projects being evaluated.

The WVA models assess the suitability of each habitat type for providing resting, foraging, breeding, and nursery habitat to a diverse assemblage of fish and wildlife species. This standardized, multi-species, habitat-based methodology facilitates the assessment of project-induced impacts on fish and wildlife resources.

The WVA marsh models consists of six variables: 1) percent of wetland area covered by emergent marsh; 2) percent open water covered by submerged aquatic vegetation; 3) marsh edge and interspersion; 4) percent of the open water area <= 1.5 feet deep; 5) salinity; and 6) aquatic organism access.

Target years were established when significant changes in habitat quality or quantity were expected during the project life, under FWP and FWOP conditions. Because construction of some levee segments would begin in 2015, a 70-year period would be required to evaluate impacts through the entire project life. Therefore, to evaluate project measures consistently, all measures were evaluated over a 70-year period.

The product of an HSI and the acreage of available habitat for a given target year is known as the Habitat Unit (HU). The HU is the basic unit for measuring project effects on fish and wildlife habitat. Future HUs change according to changes in habitat quality and/or quantity. Results are annualized over the period of analysis to determine the Average Annual Habitat Units (AAHUs) available for each habitat type.

The change in AAHUs for each FWP scenario, compared to FWOP project conditions, provides a measure of anticipated impacts. A net gain in AAHUs indicates that the project is beneficial to the habitat being evaluated; a net loss of AAHUs indicates that the project is damaging to that habitat type.

Construction of the proposed levee segments would replace a FWOP functional marsh with a levee and borrow canal under FWP. Because the deep waters of navigation canals and major bayous are assumed to provide little if any habitat value, such waterbodies are typically excluded from the project area. Therefore, the HET assumed that the deep water of the FWP borrow canal would also be of little value, and hence, was excluded from the FWP project area. Since there would be no remaining habitat quantity or quality FWP, the final WVA results were taken as the sum of marsh + water FWOP AAHUs.

Although the WVA methodology is relatively easy to use, the study schedule did not allow for collection of field data for WVA inputs. Instead, best professional judgment (based on past site visits) was used to provide Variable 2 and Variable 4 inputs necessary to the WVA (percent submerged aquatic vegetation and percent shallow open water, respectively). Wetland acreage predictions discussed above were used to provide V1 values. However, one WVA assessed impacts to wetlands under forced drainage along Four Pointe Bayou. Those wetlands were assumed to experience no loss throughout the 70-year evaluation period.

Salinity modeling (conducted using 2004 input data) was assumed to represent baseline and construction year salinity values. The model outputs consisted of average subunit salinities at 15 minute intervals throughout the year for FWOP and for a FWP scenario with all floodgates and structures open year-round. Effects of short-term HNC Lock closures to reduce saltwater intrusion were not incorporated into the project scenarios modeled, and therefore were not reflected in FWP V5 values for the direct impact assessments. The output 15 minute salinity values were averaged as needed to provide V5 inputs. Predicted salinities under future with SLR conditions were not available within the study schedule. Hence, the HET had to assume that future salinities would remain the same as in 2004. For all levee segments, FWOP V6 was assumed to be unrestricted (V6 = 1.0). FWOP WVA variables used to assess direct impacts are listed in Tables A and B.

Table A. FWOP WVA variables for assessing direct impacts of 35-year protection features scheduled for immediate construction.

Levee Reach	Loss Subunit	Habitat Type	35-Year Levee Alternative Low SLR					35-Year Levee Alternative Medium SLR					35-Year Levee Alternative High SLR				
			TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-2	B13	INT	V1	81	79	0	0	V1	81	79	0	0	V1	81	79	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	80	80			V3-1	80	80			V3-1	80	80		
			V3-2	10	10			V3-2	10	10			V3-2	10	10		
			V3-3	10	10			V3-3	10	10			V3-3	10	10		
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	35	35	3	0	V4	35	35	3	0	V4	35	35	2	0
			V5	0	0	0	0	V5	0	0	0	0	V5	0	0	0	0
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6					V6					V6				
			V6	1.00	1.00	1.00	1.00	V6	1.00	1.00	1.00	1.00	V6	1.00	1.00	1.00	1.00
			TOT Ac	151	151	151	151	TOT Ac	151	151	151	151	TOT Ac	151	151	151	151
			% MF	0	0	0	0	% MF	0	0	0	0	% MF	0	0	0	0
			% INT	100	100	100	100	% INT	100	100	100	100	% INT	100	100	100	100

Levee Reach	Loss Subunit	Habitat Type	TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-1	B13	INT	V1	88	86	0	0	V1	88	86	0	0	V1	88	86	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	20	20	1	0	V4	20	20	1	0	V4	20	20	1	0
			V5	0	0	5	5	V5	0	0	5	5	V5	0	0	5	5
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6	0	0	1	1	V6	0	0	1	1	V6	0	0	1	1
			V6	1	1	1	1	V6	1	1	1	1	V6	1	1	1	1
			TOT Ac	76	76	76	76	TOT Ac	76	76	76	76	TOT Ac	76	76	76	76
			% MF	7	7	7	7	% MF	7	7	7	7	% MF	7	7	7	7
			% INT	93	93	93	93	% INT	93	93	93	93	% INT	93	93	93	93

Levee Reach	Loss Subunit	Habitat Type	TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-1	B13	BR	V1	82	80	0	0	V1	82	80	0	0	V1	82	80	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	60	60	1	0	V4	60	60	1	0	V4	60	60	1	0
			V5					V5					V5				
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6					V6					V6				
			V6	1	1	1	1	V6	1	1	1	1	V6	1	1	1	1
			TOT Ac	11	11	11	11	TOT Ac	11	11	11	11	TOT Ac	11	11	11	11

Table A. FWOP WVA variables for assessing direct impacts of 35-year protection features scheduled for immediate construction – continued.

			35-Year Levee Alternative					35-Year Levee Alternative					35-Year Levee Alternative				
Levee	Loss	Habitat	Low SLR					Medium SLR					High SLR				
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1		70
F-1	B15	BR	V1	77	77		53	V1	77	77		41	V1	77	77		1
			V2	0	0		0	V2	0	0		0	V2	0	0		0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2				30	V3-2				20	V3-2				
			V3-3	30	30		40	V3-3	30	30		40	V3-3	30	30		
			V3-4				30	V3-4				40	V3-4				
			V3-5					V3-5					V3-5				100
			V4	15	15		6	V4	15	15		5	V4	15	15		0
			V5					V5					V5				
			V5	5	5		5	V5	5	5		5	V5	5	5		5
			V6					V6					V6				
			V6	1	1		1	V6	1	1		1	V6	1	1		1
			TOT Ac	244	244		244	TOT Ac	244	244		244	TOT Ac	244	244		244

Levee	Loss	Habitat															
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	60	70
F-1	C21	BR	V1	70	70		32	V1	70	70		20	V1	70	70	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0		0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3				20	V3-3				15	V3-3				
			V3-4				80	V3-4				85	V3-4				
			V3-5					V3-5					V3-5			100	100
			V4	25	25		5	V4	25	25		3	V4	25	25	0	0
			V5					V5					V5				
			V5	8	8		8	V5	8	8		8	V5	8	8	8	8
			V6					V6					V6				
			V6	1	1		1	V6	1	1		1	V6	1	1	1	1
			TOT Ac	36	36		36	TOT Ac	36	36		36	TOT Ac	36	36	36	36

Levee	Loss	Habitat															
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	60	70
F-1 Ea.	C20	BR	V1	93	93		43	V1	93	93		27	V1	93	92	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0	0	0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2					V3-2					V3-2				
			V3-3	30	30		90	V3-3	30	30			V3-3	30	30		
			V3-4				10	V3-4				30	V3-4				
			V3-5					V3-5				70	V3-5			100	100
			V4	5	5		2	V4	5	5		0	V4	5	5	0	0
			V5					V5					V5				
			V5	6	6		6	V5	6	6		6	V5	6	6	6	6
			V6					V6					V6				
			V6	1	1		1	V6	1	1		1	V6	1	1	1	1
			TOT Ac	4	4		4	TOT Ac	4	4		4	TOT Ac	4	4	4	4

Table A. FWOP WVA variables for assessing direct impacts of 35-year protection features scheduled for immediate construction – continued.

			35-Year Levee Alternative					35-Year Levee Alternative					35-Year Levee Alternative				
Levee	**Loss**	**Habitat**	**Low SLR**					**Medium SLR**					**High SLR**				
Reach	**Subunit**	**Type**	TY	0	1		70	TY	0	1		70	TY	0	1	59	70
G-1	**C20**	**BR**	V1	80	80		36	V1	80	80		22	V1	80	79	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0	0	0
			V3-1					V3-1					V3-1				
			V3-2	100	100			V3-2	100	100			V3-2	100	100		
			V3-3				50	V3-3				30	V3-3				
			V3-4				50	V3-4				70	V3-4				
			V3-5					V3-5					V3-5			100	100
			V4	5	5		1	V4	5	5		1	V4	5	5	0	0
			V5					V5					V5				
			V5	6	6		6	V5	6	6		6	V5	6	6	6	6
			V6					V6					V6				
			V6	1	1		1	V6	1	1		1	V6	1	1	1	1
			TOT Ac	2	2		2	TOT Ac	2	2		2	TOT Ac	2	2	2	2
Levee	**Loss**	**Habitat**															
Reach	**Subunit**	**Type**	TY	0	1		70	TY	0	1		70	TY	0	1	59	70
G1	**C21**	**BR**	V1	77	76		34	V1	77	76		20	V1	77	76	0	0
			V2	5	5		0	V2	5	5		0	V2	5	5	0	0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2					V3-2					V3-2				
			V3-3	30	30			V3-3	30	30			V3-3	30	30		
			V3-4				40	V3-4				30	V3-4				
			V3-5				60	V3-5				70	V3-5			100	100
			V4	7	7		2	V4	7	7		1	V4	7	7	0	0
			V5					V5					V5				
			V5	8	8		8	V5	8	8		8	V5	8	8	8	8
			V6					V6					V6				
			V6	1	1		1	V6	1	1		1	V6	1	1	1	1
			TOT Ac	143	143		143	TOT Ac	143	143		143	TOT Ac	143	143	143	143
Levee	**Loss**	**Habitat**															
Reach	**Subunit**	**Type**	TY	TY	1		70	TY	0	1		70	TY	0	1	70	
G1	**C19**	**FM**	V1	73	73		73	V1	73	73		73	V1	73	73	73	
	Force		V2	10	10		10	V2	10	10		10	V2	10	10	10	
	Drained		V3-1	65	65		65	V3-1	65	65		65	V3-1	65	65	65	
			V3-2	35	35		35	V3-2	35	35		35	V3-2	35	35	35	
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5					V3-5					V3-5				
			V4	65	65		65	V4	65	65		65	V4	65	65	65	
			V5					V5					V5				
			V5	0	0		0	V5	0	0		0	V5	0	0	0	
			V6					V6					V6				
			V6	0	0		0	V6	0	0		0	V6	0	0	0	
			TOT Ac	19	19		19	TOT Ac	19	19		19	TOT Ac	19	19	19	
			% MF	100	100		100	% MF	100	100		100	% MF	100	100	100	
			% INT	0	0		0	% INT	0	0		0	% INT	0	0	0	

Table B. FWOP WVA variables for assessing direct impacts of 100-year protection features scheduled for immediate construction.

Levee Reach	Loss Subunit	Habitat Type	100-Year Levee Alternative Low SLR					100-Year Levee Alternative Medium SLR					100-Year Levee Alternative High SLR				
			TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-2	B13	INT	V1	79	78	0	0	V1	79	78	0	0	V1	79	78	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	85	85			V3-1	85	85			V3-1	85	85		
			V3-2	7	7			V3-2	7	7			V3-2	7	7		
			V3-3	8	8			V3-3	8	8			V3-3	8	8		
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	25	25	1	0	V4	25	25	1	0	V4	25	25	1	0
			V5	0	0	5	5	V5	0	0	5	5	V5	0	0	5	5
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6	0.0	0.0	0.0	0.0	V6	0.0	0.0	0.0	0.0	V6	0.0	0.0	0.0	0.0
			V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	188	188	188	188	TOT Ac	188	188	188	188	TOT Ac	188	188	188	188
			% FM	0	0	0	0	% FM	0	0	0	0	% FM	0	0	0	0
			% INT	100	100	100	100	% INT	100	100	100	100	% INT	100	100	100	100
Levee Reach	Loss Subunit	Habitat Type	TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-1	B13	INT	V1	86	85	0	0	V1	86	85	0	0	V1	86	85	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	20	20	1	0	V4	20	20	1	0	V4	20	20	1	0
			V5	0	0	5	5	V5	0	0	5	5	V5	0	0	5	5
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6	0	0	1	1	V6	0	0	1	1	V6	0	0	1	1
			V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	85	85	85	85	TOT Ac	85	85	85	85	TOT Ac	85	85	85	85
			% FM	4	4	4	4	% FM	4	4	4	4	% FM	4	4	4	4
			% INT	96	96	96	96	% INT	96	96	96	96	% INT	96	96	96	96
Levee Reach	Loss Subunit	Habitat Type	TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-1	B13	BR	V1	81	80	0	0	V1	81	79	0	0	V1	81	79	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	60	60	1	0	V4	60	60	1	0	V4	60	60	1	0
			V5					V5					V5				
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6					V6					V6				
			V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	12	12	12	12	TOT Ac	12	12	12	12	TOT Ac	12	12	12	12

Table B. FWOP WVA variables for assessing direct impacts of 100-year protection features scheduled for immediate construction - continued.

			100-Year Levee Alternative					100-Year Levee Alternative					100-Year Levee Alternative				
Levee	Loss	Habitat	Low SLR					Medium SLR					High SLR				
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1		70
F-1	B15	BR	V1	76	75		52	V1	75	75		40	V1	75	75		1
			V2	0	0		0	V2	0	0		0	V2	0	0		0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2				30	V3-2				20	V3-2				
			V3-3	30	30		40	V3-3	30	30		40	V3-3	30	30		
			V3-4				30	V3-4				40	V3-4				
			V3-5					V3-5					V3-5				100
			V4	15	15		6	V4	15	15		5	V4	15	15		0
			V5					V5					V5				
			V5	5	5		5	V5	5	5		5	V5	5	5		5
			V6					V6					V6				
			V6	1.0	1.0		1.0	V6	1.0	1.0		1.0	V6	1.0	1.0		1.0
			TOT Ac	258	258		258	TOT Ac	258	258		258	TOT Ac	258	258		258

Levee	Loss	Habitat															
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	60	70
F-1	C21	BR	V1	86	85		38	V1	86	85		24	V1	86	85	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3				20	V3-3				15	V3-3				
			V3-4				80	V3-4				85	V3-4				
			V3-5					V3-5					V3-5			100	100
			V4	25	25		5	V4	25	25		3	V4	25	25	0	0
			V5					V5					V5				
			V5	8	8		8	V5	8	8		8	V5	8	8	8	8
			V6					V6					V6				
			V6	1.0	1.0		1.0	V6	1.0	1.0		1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	92	92		92	TOT Ac	92	92		92	TOT Ac	92	92	92	92

Levee	Loss	Habitat															
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	60	70
F-1 Ea.	C20	BR	V1	93	93		43	V1	93	93		27	V1	93	92	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3				90	V3-3					V3-3				
			V3-4				10	V3-4				30	V3-4				
			V3-5					V3-5				70	V3-5			100	100
			V4	5	5		2	V4	5	5		0	V4	5	5	0	0
			V5					V5					V5				
			V5	6	6		6	V5	6	6		6	V5	6	6	6	6
			V6					V6					V6				
			V6	1.0	1.0		1.0	V6	1.0	1.0		1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	4	4		4	TOT Ac	4	4		4	TOT Ac	4	4	4	4

Table B. FWOP WVA variables for assessing direct impacts of 100-year protection features scheduled for immediate construction - continued.

			100-Year Levee Alternative					100-Year Levee Alternative					100-Year Levee Alternative				
Levee	Loss	Habitat	Low SLR					Medium SLR					High SLR				
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	59	70
G-1	C20	BR	V1	69	69		31	V1	69	69		19	V1	69	69	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0	0	0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2					V3-2					V3-2				
			V3-3	30	30		50	V3-3	30	30		30	V3-3	30	30		
			V3-4				50	V3-4				70	V3-4				
			V3-5					V3-5					V3-5			100	100
			V4	10	10		2	V4	10	10		1	V4	10	10	0	0
			V5					V5					V5				
			V5	6	6		6	V5	6	6		6	V5	6	6	6	6
			V6					V6					V6				
			V6	1.0	1.0		1.0	V6	1.0	1.0		1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	4	4		4	TOT Ac	4	4		4	TOT Ac	4	4	4	4
Levee	Loss	Habitat															
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	59	70
G1	C21	BR	V1	78	78		35	V1	78	77		21	V1	78	77	0	0
			V2	5	5		0	V2	5	5		0	V2	5	5	0	0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2					V3-2					V3-2				
			V3-3	30	30			V3-3	30	30			V3-3	30	30		
			V3-4				40	V3-4				30	V3-4				
			V3-5				60	V3-5				70	V3-5			100	100
			V4	7	7		2	V4	7	7		1	V4	7	7	0	0
			V5					V5					V5				
			V5	8	8		8	V5	8	8		8	V5	8	8	8	8
			V6					V6					V6				
			V6	1.0	1.0		1.0	V6	1.0	1.0		1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	175	175		175	TOT Ac	175	175		175	TOT Ac	175	175	175	175
Levee	Loss	Habitat															
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	70	
G1	C19	FM	V1	79	79		79	V1	79	79		79	V1	79	79	79	
	Force		V2	10	10		10	V2	10	10		10	V2	10	10	10	
	Drained		V3-1	65	65		65	V3-1	65	65		65	V3-1	65	65	65	
			V3-2	35	35		35	V3-2	35	35		35	V3-2	35	35	35	
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5					V3-5					V3-5				
			V4	65	65		65	V4	65	65		65	V4	65	65	65	
			V5					V5					V5				
			V5	0	0		0	V5	0	0		0	V5	0	0	0	
			V6					V6					V6				
			V6	0.0	0.0		0.0	V6	0.0	0.0		0.0	V6	0.0	0.0	0.0	
			TOT Ac	33	33		33	TOT Ac	33	33		33	TOT Ac	33	33	33	
			% FM	100	100		100	% FM	100	100		100	% FM	100	100	100	
			% INT	0	0		0	% INT	0	0		0	% INT	0	0	0	

Indirect Impacts WVAs

In addition to direct construction impacts, project implementation might alter hydroperiod, salinity, and fish access to enclosed wetlands. Exterior wetlands could also be affected through project-induced salinity reductions and/or salinity increases. The HET examined hydrologic model results regarding project-induced water level changes. There was little if any change, and the HET assumed that those changes were not significant. Consequently, the HET did not attempt to assess impacts associated with project-induced changes in hydroperiod.

The HET also examined predicted salinity changes for subunits inside and outside the levee system. Because FWP salinities did not include the anticipated short-term HNC Lock closures to provide saltwater intrusion protection, the HET merged salinity outputs from a model run where the Lock was closed year-round with Plan 1 outputs (all gates open year-round) to create a Modified Plan 1 salinity output. Due to widely varying estimates of Lock closure duration, substantial uncertainty regarding Modified Plan 1 salinities, and the relatively minor change in predicted Modified Plan 1 salinities (which used a liberal estimate of lock closure duration), the HET decided that project-induced salinity reductions were too uncertain to quantify at this time. Predicted salinity increases were noted for marshes south of the Lock, during lock closure periods. However, the salinities remained within the optimal brackish marsh range according to WVA models. As a result, the HET decided not to assess benefits or impacts associated with project-induced salinity increases or decreases.

Because all Morganza floodgates and environmental structures would be closed only upon approach of a tropical storm, fisheries access interruptions would occur on average roughly 1 or 2 days per year. However, the duration of HNC Lock closures to reduce saltwater intrusion would likely be greater, and could result in quantifiable fish access interruptions. However, there were substantial uncertainties regarding the duration of lock closures. Additionally, effects of HNC Lock closures would potentially be reduced because the adjoining Bayou Grand Caillou floodgate would remain open to provide fish access. Lacking more definitive information on project-induced water exchange flux, the HET decided that the uncertainties were too great to propose project-induced reductions in fisheries access. As a result of its evaluations, the HET decided not to quantify any indirect impacts or indirect benefits associated with project implementation due to hydrology changes or fisheries access reductions

Mitgation WVAs.

To compensate for marsh losses associated with construction of levee reaches F1, F2, G1, the HNC Lock, and the Bayou Grand Caillou Floodgate, the HET evaluated several marsh creation projects under the medium SLR scenario. Construction impacts to fresh and intermediate marshes would be mitigated by marsh creation in the intermediate marshes of subunit B13 (open water areas south of Falgout Canal). Construction impacts to brackish marshes would be mitigated via marsh creation in the Felix Lake area (subunit B15 open water area immediately west of the HNC Lock). WVA variables used to quantify benefits of proposed marsh creation measures are provided in Table C.

Table C. WVA variables used to determine benefits of potential marsh creation mitigation projects.

		Medium SLR				Medium SLR					
Loss Subunit	Habitat Type		FWOP TY0	FWOP TY1	FWOP TY70	FWP TY1	FWP TY3	FWP TY5	FWP TY6	FWP TY32	FWP TY70
B13	**INT**	V1	0	0	0	10	25	97	96	77	19
		V2	0	0	0	0	0	0	0	0	0
		V3-1						50	100	77	
		V3-2								23	
		V3-3					100	50			
		V3-4									15
		V3-5	100	100	100	100					85
		V4	20	20	0	100	100	100	100	100	5
		V5	0	0	0	0	0	0	0	0	0
		V5	5	5	5	4	4	4	4	4	4
		V6									
		V6	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00
		TOT Ac	100	100	100	100	100	100	100	100	100
		% FM	0	0	0	0	0	0	0	0	0
		% INT	100	100	100	100	100	100	100	100	100
Loss Subunit	**Habitat Type**		FWOP TY0	FWOP TY1	FWOP TY70	FWP TY1	FWP TY3	FWP TY5	FWP TY6	FWP TY32	FWP TY70
B15	**BR**	V1	0	0	0	10	25	99	99	90	64
		V2	0	0	0	0	0	0	0	0	0
		V3-1	70	70				50	100	90	
		V3-2			20					10	25
		V3-3	30	30	40		100	50			75
		V3-4			40						
		V3-5				100					
		V4	60	60	0	100	100	100	100	100	70
		V5									
		V5	5	5	5	4	4	4	4	4	4
		V6									
		V6	1	1	1	0.00	0.00	1	1	1	1
		TOT Ac	500	500	500	500	500	500	500	500	500

Predicting Future Acreage of Marsh Creation Mitigation Projects

Mathematical formulas were developed for use in Excel spreadsheets to calculate net marsh creation project acres over time. A number of assumptions regarding loss rate reduction and the rate at which vegetation colonizes the created marsh platform were incorporated into those formulas and calculate the acres of functioning marsh for every year of the project life. To include the additional marsh loss under the medium and high SLR scenarios, the formulas under those scenarios were more complex than the formulas to calculate marsh creation acres under the low SLR scenario.

Marsh Creation Assumptions:

a) The created marsh loss rate is initially 50% of the loss rate of surrounding marshes provided that accretion above the created marsh platform is less than 10 inches.

b) The loss rate of created marsh will revert to background or baseline loss rates once 10 inches or more of post-construction accretion has occurred above the constructed marsh platform.

c) Given a study area average accretion rate of 0.91 cm/yr (Table D), and assuming an initial 3-yr settling period, 31 years is required to accrete 10 inches of soil above the created marsh platform. Prior to that time, loss rate is 50% of the background loss rate. Once 10 inches of soil has accreted, the loss rate reverts back to 100% of the background rate.

d) The FWOP condition is assumed to be all open water. Consequently, no formulas are needed to calculate FWOP marsh loss over time.

e) Functionality/vegetation of the created brackish marsh is per standard planted marsh protocols (TY1 = 10%, TY3=25%, TY5= 100%).

f) Functionality/vegetation of the created intermediate marsh is per standard planted marsh protocols (TY1= 10%, TY3=25%, TY5=100%).

g) Percent functionality for TY2 and TY4 is assumed to be midway between percent functionality values for the year before and after (TY2 is 18% and TY4 is 63%).

h) Loss of constructed marsh platform assumed to occur immediately after construction (at 50% of the marsh loss rate), independent of percent functionality/vegetation.

Formula inputs include:

1. AC – the acres of marsh to be created.
2. YC - year in which the marsh creation project is constructed.
3. MCLR - marsh creation loss rate in acres/yr. Calculated as (Polygon loss rate * Created acres)*50%. A loss rate is indicated by a negative value.
4. RCH - year FWP loss rate reverts from 50% of the polygon loss rate to 100% of the polygon loss rate. This year is calculated as the YC + 31 years.
5. YR – calendar year
6. SLR – additional loss rate due to increased sea level rise under the medium and high SLR scenarios (see Figure 5 and associated discussion above). SLR values increase each year after sea level rise acceleration begins in 2010.
7. PAC - prior year's marsh creation acreage.

Table D. Terrebonne Basin marsh soil accretion measurements from Jarvis (2010).

Location	Time Period	Habitat Type	Method	(cm/yr)	Reference
Deteriorating brackish	1989-1994	Brackish	137Cs	0.96	Nyman et al., 2006
Stable brackish	1989-1994	Brackish	137Cs	0.88	Nyman et al., 2006
N Billy Goat Bay	1963-1990	Brackish/saline	137Cs	1.06	Nyman et al., 1993
N Madison Bay	1963-1990	Brackish/saline	137Cs	1.33	Nyman et al., 1993
SE Madison Bay	1963-1990	Brackish/saline	137Cs	0.67	Nyman et al., 1993
W Madison Bay	1963-1990	Brackish/saline	137Cs	0.78	Nyman et al., 1993
Bay la Peur	1963-1990	Saline	137Cs	0.78	Nyman et al., 1993
Charles Theriot	1963-1990	Saline	137Cs	0.98	Nyman et al., 1993
Chitigue (upstream)	1963-1990	Saline	137Cs	1.22	Nyman et al., 1993
Chitigue (midstream)	1963-1990	Saline	137Cs	0.75	Nyman et al., 1993
Chitigue (downstream)	1963-1990	Saline	137Cs	0.98	Nyman et al., 1993
deMangue (upstream)	1963-1990	Saline	137Cs	0.94	Nyman et al., 1993
deMangue (midstream)	1963-1990	Saline	137Cs	1.28	Nyman et al., 1993
deMangue (downstream)	1963-1990	Saline	137Cs	0.56	Nyman et al., 1993
DuFrene	1963-1990	Saline	137Cs	0.55	Nyman et al., 1993
Fourleauge Bay	1975-1979	Saline	137Cs	0.66	Baumann et al., 1984
Grand Bayou	1963-1990	Saline	137Cs	1.04	Nyman et al., 1993
Lake Barre	1963-1990	Saline	137Cs	1.78	Nyman et al., 1993
Old Oyster Bayou	1992-2000	Saline	137Cs	0.48	Rybczyk and Cahoon, 2002
Stable saline	1989-1994	Saline	137Cs	0.59	Nyman et al., 2006
			Average =	**0.91**	

FWP Excel Formula for Marsh Creation Acres – Low SLR Scenario:
=IF(YR<YC,0,IF(YR=YC,(AC+MCLR)*0.1,IF(YR=YC+1,(AC+2*MCLR)*0.18,IF(YR=YC+2,(AC+3*MCLR)*0.25,IF(YR=YC+3,(AC+4*MCLR)*0.63,IF(YR=YC+4,(AC+5*MCLR),IF(YR<RCH,IF(PAC+MCLR<0,0,PAC+MCLR),IF(PAC+2*MCLR<0,0,PAC+2*MCLR)))))))).

FWP Excel Formula for Marsh Creation Acres – Medium and High Scenario:
=IF(YR<YC,0,IF(YR=YC,(AC+MCLR+SLR*AC)*0.1,IF(YR=YC+1,(AC+2*MCLR+SLR*AC)*0.18, IF(YR=YC+2,(AC+3*MCLR+SLR*AC)*0.25,IF(YR=YC+3,(AC+4*MCLR+SLR*AC)*0.63, IF(YR=YC+4,(AC+5*MCLR+SLR*AC),IF(YR<RCH,IF(PAC+MCLR+AC*SLR<0,0,PAC+MCLR+AC*SLR),IF(PAC+2MCLR+AC*SLR<0,0,PAC+MCLR+AC*SLR)))))))).

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Baumann, R. H., J. W. Day, and C. A. Miller. 1984. Mississippi deltaic wetland survival: Sedimentation versus coastal submergence. *Science* 224: 1093-1095.

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Louisiana Coastal Wetlands Conservation and Restoration Task Force. 2006b. Coastal Wetlands Planning, Protection, and Restoration Act - Wetland Value Assessment Methodology: Procedural Manual. Environmental Work Group. 23 pp.

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Rybczyk, J. M., and D. R. Cahoon. 2002. Estimating the potential for submergence for two wetlands in the Mississippi River delta. *Estuaries* 25(5): 985-998.

DEPARTMENT OF THE ARMY
MISSISSIPPI VALLEY DIVISION, CORPS OF ENGINEERS
P.O. BOX 80
VICKSBURG, MISSISSIPPI 39181-0080

REPLY TO
ATTENTION OF:

CEMVD-PD-N 12 March 2012

MEMORAMDUM FOR CECW-PC (Wes Coleman)

SUBJECT: Wetland Value Assessment Models – Marsh Model, Recommendation for Single Use Approval on Multiple Projects

1. References

a. Engineering Circular 1105-2-412: Assuring Quality of Planning Models, dated 31 March 2011.

b. CEMVN Memorandum Subject: Wetland Value Assessment Models – Marsh Model, Summary of Model Review Results and Recommendation for Interim Approval, dated 6 February 2012.

2. The National Ecosystem Planning Center of Expertise (ECO-PCX) recommended approval of the Wetland Value Assessment (WVA) Coastal Marsh Community Models 1.0 for in Reference a. The Headquarters Model Certification Team discussed the Coastal Marsh Community model on 14 February 2012 and requested a list of projects that plan to use the model over the next 5 years. Below is a list of projects that plan to use the Coastal Marsh Model.

a. MRGO Ecosystem Restoration
b. Barataria Basin Barrier Shoreline
c. Lake Pontchatrain and Vicinity Hurricane Storm Damage Risk Reduction System (HSDRRS) Mitigation
d. West Bank and Vicinity HSDRRS Mitigation
e. HSDRRS IERS – multiple total number unknown
f. Louisiana Coastal Area (LCA)4 Davis Pond Modification
g. LCA4 Modification to Caernarvon
h. LCA4 Point Au Fer Island
i. LCA4 Caillou Lake Land Bridge
j. LCA Myrtle Grove
k. LCA White Ditch PED
l. LCA Mississippi River Hydrodynamic and Delta Management
m. LCA Caernarvon
n. Larose to Golden Meadow (LGM) Post-Authorization Change (PAC) Study and SEIS
o. Larose to Golden Meadow Intracoastal Floodwall Reach 2b (LGM-022C).
p. Larose to Golden Meadow Intracoastal Floodwall Reach 2a (LGM-022B).
q. Larose to Golden Meadow C-North Highway 24 Relocation (LGM-001C).
r. Baptiste Collette Bayou Deepening study (Conducted by local interests under WRDA 86, Section 203)

s. Barataria Bay Waterway (CAP 204)
t. Buras Marina (CAP 206)
u. Calcasieu River and Pass (CAP 204)
v. Calcasieu Lock Replacement
w. Morganza to the Gulf PAC
x. Morganza to the Gulf Supplemental NEPA documents – multiple total number unknown
y. Southwest Coastal
z. Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) – West Bay Closure
aa. Houma Navigation Canal Deepening
bb. West Shore Lake Pontchartrain Hurricane & Flood Risk Reduction
cc. LCA Terrebonne Basin Barrier Shoreline Restoration
dd. LCA Demonstration Projects Grand Isle and Vicinity Project
ee. CAP 103 Grand Isle Highway 1 Shoreline Stabilization
ff. Donalsonville to the Gulf
gg. NOV Plaquemines Parish
hh. NFL Plaquemines Parish

9. The ECO-PCX recommends a single use approval of the Wetland Value Assessment Coastal Marsh Community Model 1.0 on the projects listed above.

Jodi K. Creswell
Operational Director, Ecosystem Restoration
Planning Center of Expertise

CF:
CECW-PC (Matusiak)
CECW-CP (Kitch, Hughes)
CECW-PB (Carlson)
CECW-MVD (Redican, Lucyshyn, Marlowe)
CEMVN-PD (Constance, Young)
CEMVD-PD-N (Wilbanks, Smith, Ruff, Chewning, Kleiss, Creswell, Vigh)
CEMVN-PD-P (Miller)
CEMVN-PDN (Exnicios)
CEMVN- PDN-CEP (Stiles, Klein, Dayan, Behrens)
CEMVN-PM-OR (Bosenberg)
CEERD-EE-E (Fischenich)

Methodology for Quantifying Environmental Benefits/Impacts

The study area was divided into subunits or polygons having similar wetland loss characteristics and loss rates (Figure 1).

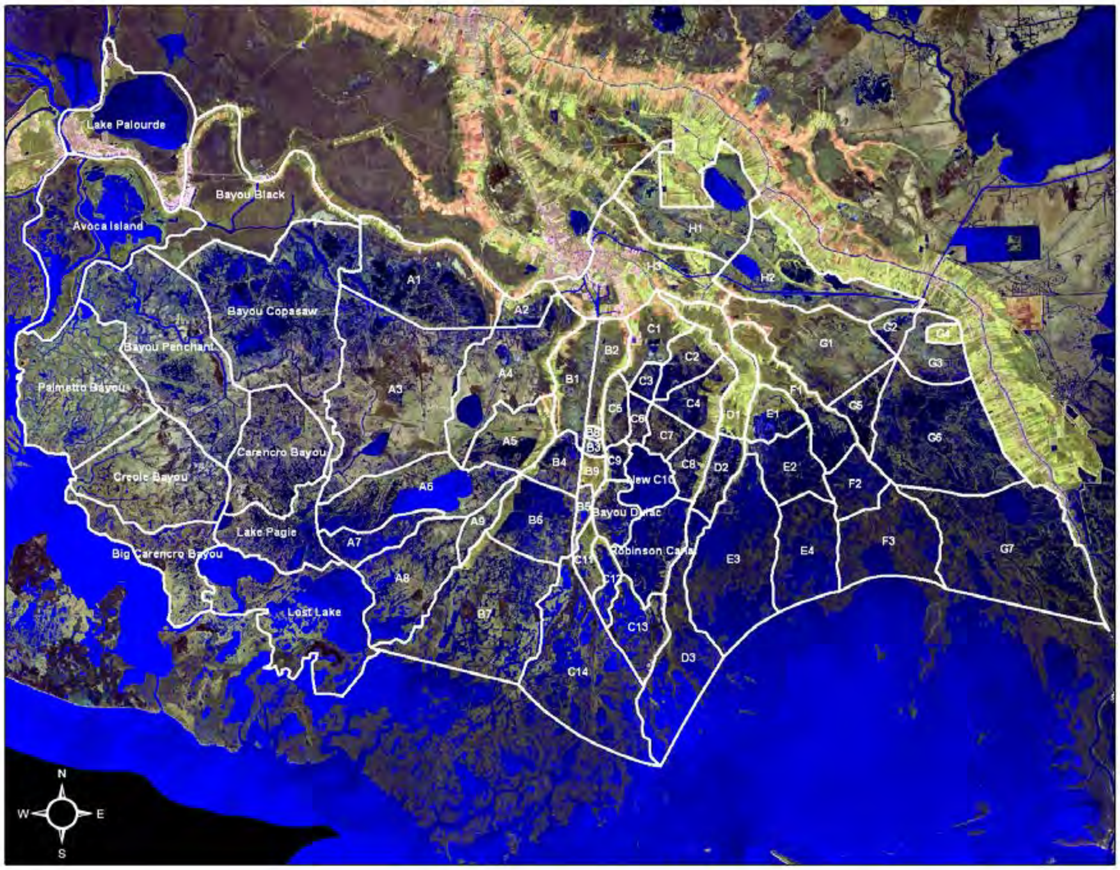

Figure 1. Map delineating study area subunits.

Wetland acreage data (1985 through 2008) was obtained from the USGS from satellite imagery for each of the study area subunits. Future-without-project (FWOP) subunit wetland acreages and marsh loss rates were determined by producing a linear trendline through the data (Figure 2) for each study area subunit. Using the trendline, marsh acreages within each study area subunit were projected from 1985 through the project life (2035 to 2085). This process applies only to coastal marshes. The conversion of forested habitats to open water or other habitat types is a much more complicated process and no simple methods are currently available to predict such habitat type changes.

The trendline projections are assumed to represent a continuation of the historic low sea level rise (SLR) scenario. However, future acreages were also calculated for two additional scenarios characterized by increasing SLR.

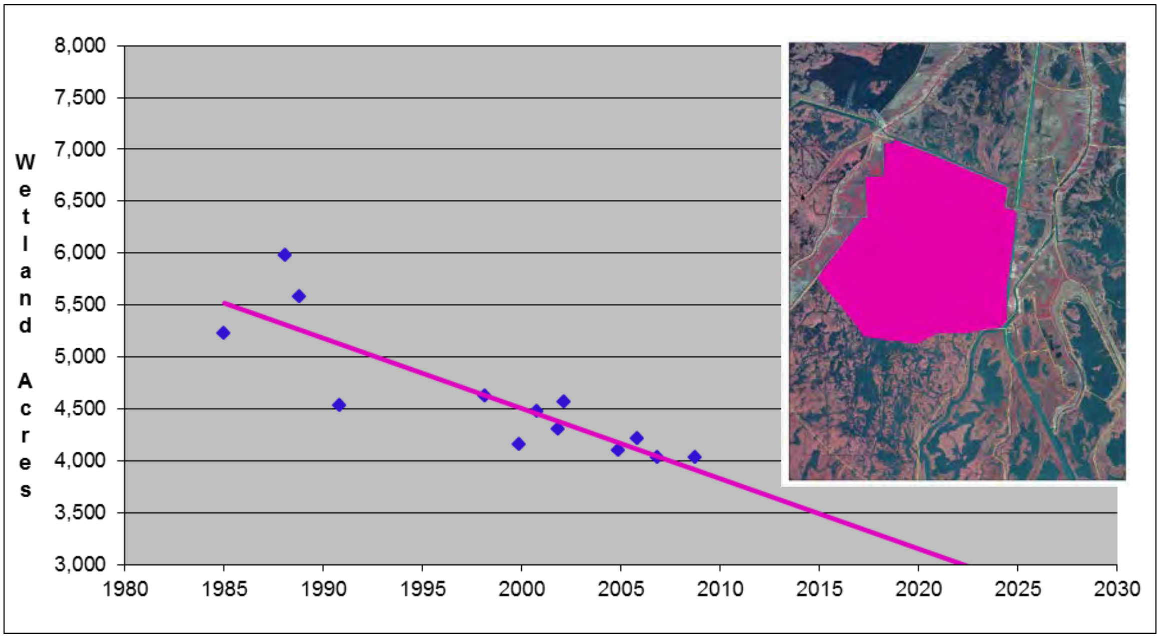

Figure 2. Observed data points and linear trendline for marshes of subunit B13.

Long-term water level gage data from the Leeville, Louisiana gage was utilized per the Corps' Engineering Circular (EC) 1165-2-212 to develop relative sea level rise associated with low (historic), intermediate, and high sea level rise estimates. According to EC guidance, the intermediate and high estimates of eustatic SLR were derived using the National Research Council (NRC) equations NRC I and NRC III, respectively. Based on the Leeville gage, the historic water level rise trend has been 6.995 mm/yr. Subtracting the historic eustatic SLR rate of 1.7 mm/yr yields a subsidence rate of 5.295 mm/yr. By adding the subsidence rate to the eustatic SLR rates associated with each SLR scenario, RSLR rates were determined for those three SLR scenarios (Figure 3).

Recent wetland loss rates (1985-2008) were assumed to have occurred under a constant low SLR rate. Therefore, for the low RSLR scenario (i.e., the continuation of the current 6.995 mm per year RSLR rate observed at the Leeville gage), the historic marsh loss rates were held constant and projected forward to provide yearly land acreages through the life of the project. For the intermediate and high scenarios, the 1985-2008 annual wetland loss rates for each subunit were gradually increased (beginning in 2010), by adding an additional annual increment of loss based on the SLR increase for that year. Those annual wetland loss rate increases were based on the slope of the negative relationship observed between wetland loss rates and RSLR rates from coastwide non-fresh marshes outside of active deltaic influences. In this relationship, RSLR was calculated as the sum of subsidence per statewide subsidence zones (see Figure 4) plus a eustatic SLR rate of 1.7

mm/yr. Recent land loss rates in percent per year were plotted against RSLR determined for those subsidence zones (Figure 5).

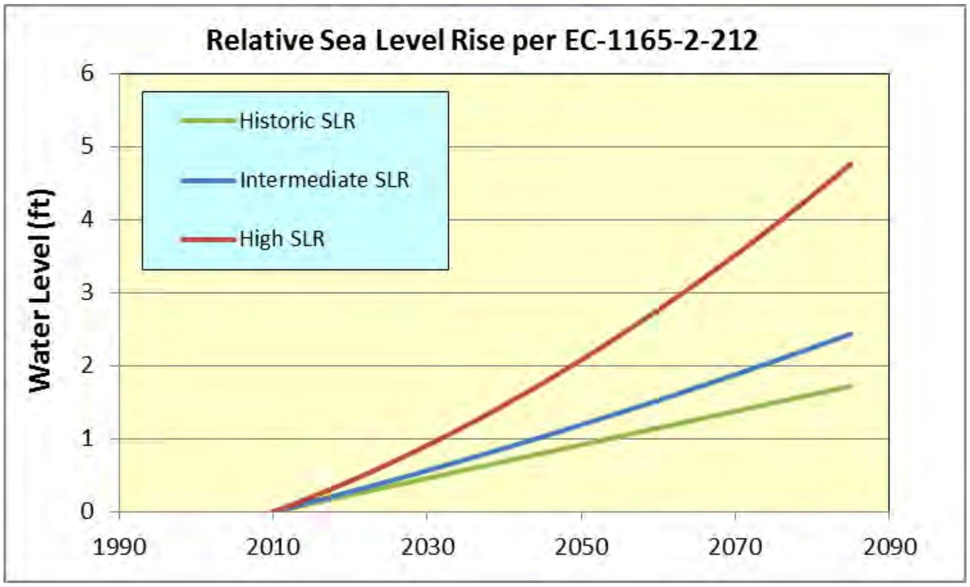

Figure 3. RSLR estimates determined using EC 1165-2-212.

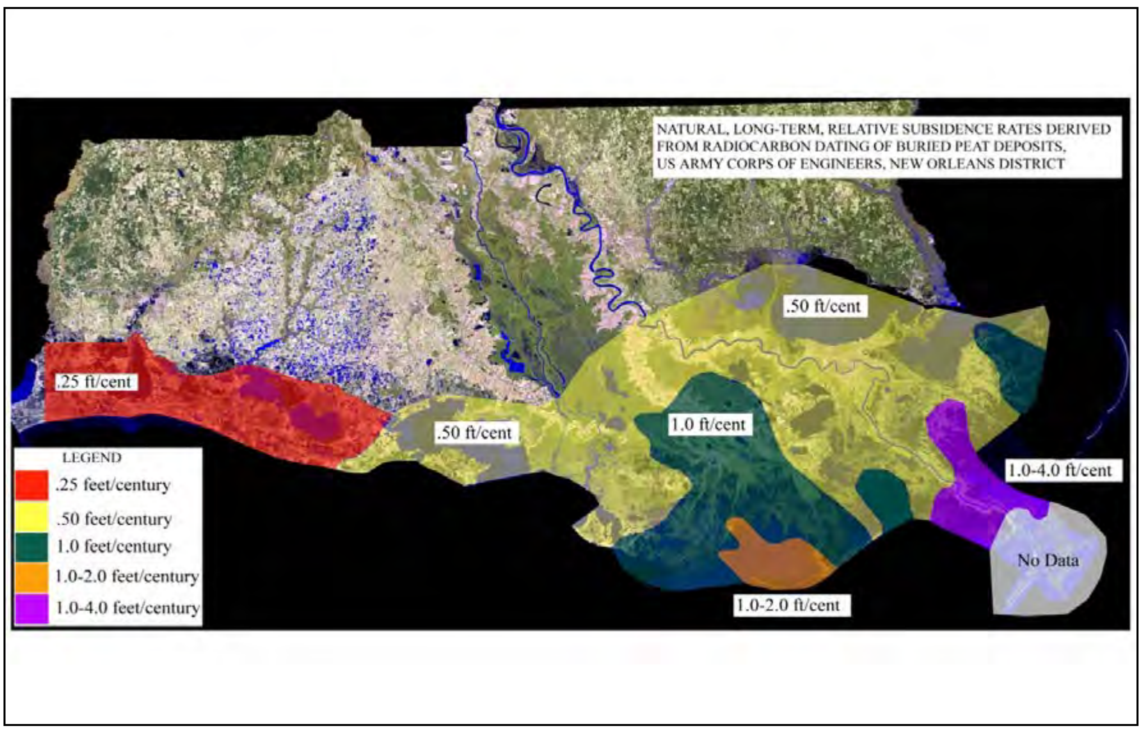

Figure 4. Coastwide subsidence zones from the Corps of Engineers.

According to the slope of this wetland loss vs RSLR relationship, every 1.0 mm/yr increase in RSLR would result in a 0.11%/yr increase in the wetland loss rate. The additional RSLR related wetland loss rate was then added to the baseline or historic loss rate to obtain total annual loss rates for each year, under the increasing sea level rise scenarios.

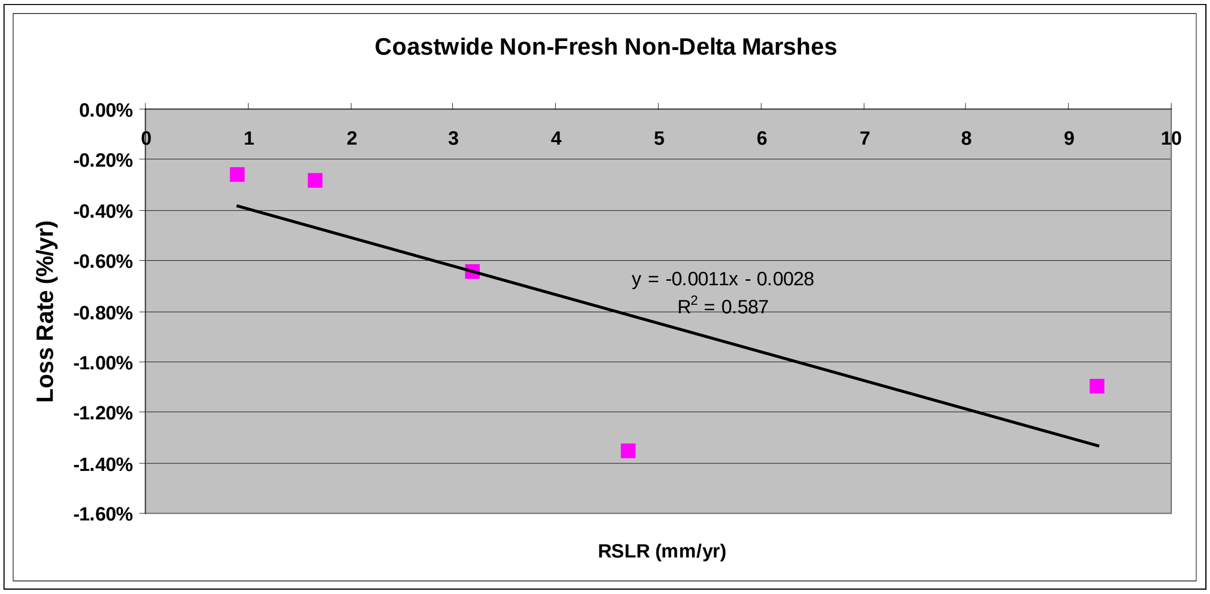

Figure 5. Coastwide wetland loss rates vs. RSLR relationship.

To determine the acreage of construction impacts in the year construction begins, National Wetland Inventory (NWI) 2008 data for the study area were obtained. Using ArcMap software, that NWI data was subdivided by each levee alternative right-of-way footprint, by individual levee reach, and by the study area loss polygons (Figure 6). The resulting data set provided acres of direct impacts in 2008, by habitat type, by levee alternative, levee reach, and loss polygon. Because of wetland loss, wetland loss rates from study area subunits, had to be applied to the 2008 NWI marsh acreages to obtain estimates of construction impacts in the year during which construction would occur.

Given the tight study schedule, the Habitat Evaluation Team (HET) agreed that the for levee segments not seeking immediate construction authorization, a tabulation of impacted habitat type acres would be sufficient for a programmatic evaluation.
However, it is desired that a detailed evaluation of levee reaches F1, F2, G1, the HNC Lock Complex and the Bayou Grand Caillou should be conducted so that those project features could be ready for authorization and construction. Accordingly, the HET decided that those features should be evaluated using the Wetland Value Assessment (WVA v1.1) methodology to assess project impacts to both habitat quantity and quality over time.

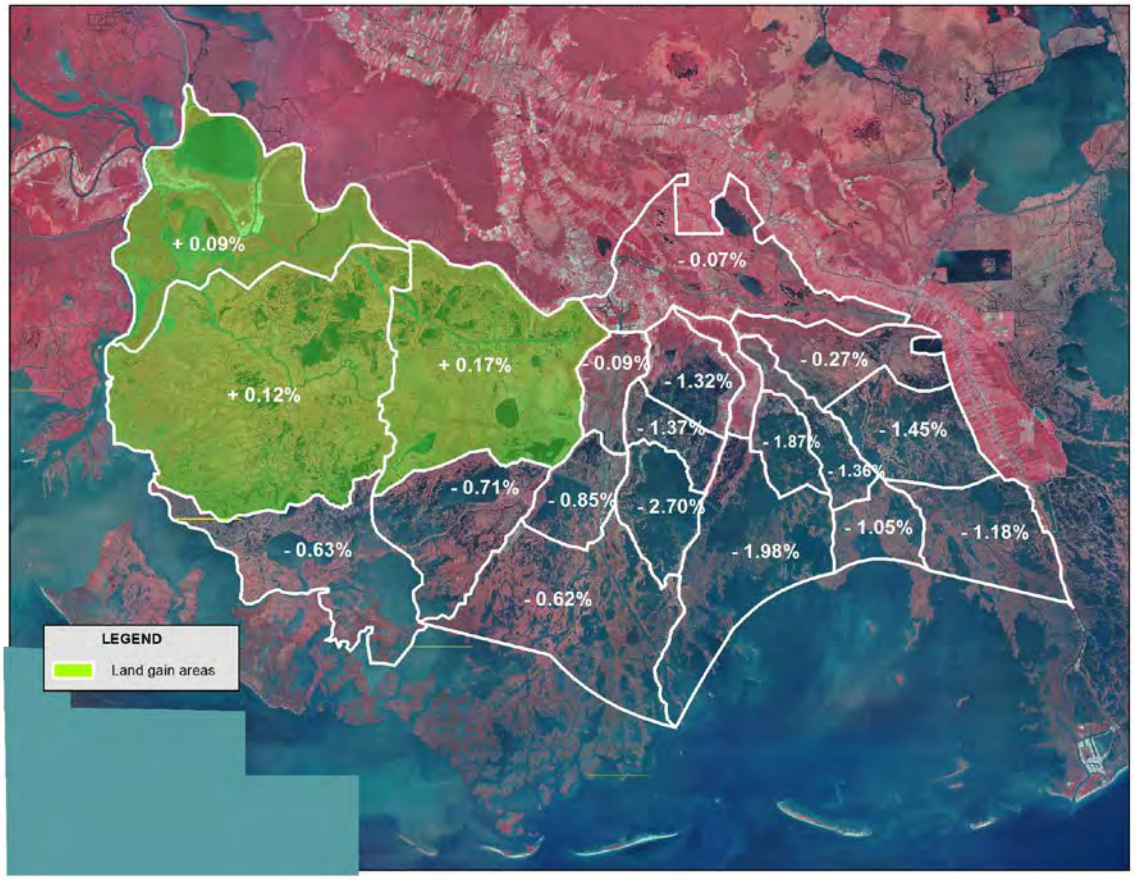

Figure 6. Land Loss Rates for each Study Area Subunit

WVA Methodology

The Wetland Value Assessment (WVA) methodology was initially developed to evaluate proposed Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) projects (LCWCRTF 2006b). The WVA methodology is similar to the Service's Habitat Evaluation Procedures (HEP), in that habitat quality and quantity are measured for baseline conditions and predicted for FWOP and FWP conditions. The Fresh/Intermediate Marsh Model and the Brackish Marsh Model were used for this project. Instead of the species-based approach of HEP, the WVA models use an assemblage of variables considered important to the suitability of a given habitat type for supporting a diversity of fish and wildlife species. As with HEP, the WVA allows a numeric comparison of each future condition and provides a combined quantitative and qualitative estimate of project-related impacts to fish and wildlife resources.

WVA models operate under the assumption that optimal conditions for fish and wildlife habitat within a given coastal wetland type can be characterized, and that existing or predicted conditions can be compared to that optimum to provide an index of habitat quality. Habitat quality is estimated and expressed through the use of a mathematical model developed specifically for each habitat type. Each model consists of: 1) a list of variables that are considered important in characterizing fish and wildlife habitat; 2) a Suitability Index graph for each variable, which defines the assumed relationship between habitat quality (Suitability Indices) and different variable values; and 3) a mathematical formula that combines the Suitability Indices for each variable into a single value for wetland habitat quality, termed the Habitat Suitability Index (HSI).

Emergent marsh habitat models have been developed for fresh, intermediate, brackish and saline marsh types. The habitat variable-habitat suitability relationships within those WVA models have not been verified by field experiments or validated through a rigorous scientific process. However, the variables were originally derived from HEP suitability indices taken from species models for species found in that habitat type. It should also be noted that some aspects of the WVA have been defined by policy and/or functional considerations of CWPPRA. However, habitat variable-habitat suitability relationships are, in most cases, supported by scientific literature and research findings. In other cases, best professional judgment by a team of fisheries biologists, wildlife biologists, ecologists, and university scientists may have been used to determine certain habitat variable-habitat suitability relationships. In addition, the WVA models have undergone a refinement process and habitat variable-habitat suitability relationships, HSIs, and other model aspects are periodically modified as more information becomes available regarding coastal fish and wildlife habitat suitability, coastal processes, and the efficacy of restoration projects being evaluated.

The WVA models assess the suitability of each habitat type for providing resting, foraging, breeding, and nursery habitat to a diverse assemblage of fish and wildlife species. This standardized, multi-species, habitat-based methodology facilitates the assessment of project-induced impacts on fish and wildlife resources.

The WVA marsh models consists of six variables: 1) percent of wetland area covered by emergent marsh; 2) percent open water covered by submerged aquatic vegetation; 3) marsh edge and interspersion; 4) percent of the open water area <= 1.5 feet deep; 5) salinity; and 6) aquatic organism access.

Target years were established when significant changes in habitat quality or quantity were expected during the project life, under FWP and FWOP conditions. Because construction of some levee segments would begin in 2015, a 70-year period would be required to evaluate impacts through the entire project life. Therefore, to evaluate project measures consistently, all measures were evaluated over a 70-year period.

The product of an HSI and the acreage of available habitat for a given target year is known as the Habitat Unit (HU). The HU is the basic unit for measuring project effects on fish and wildlife habitat. Future HUs change according to changes in habitat quality and/or quantity. Results are annualized over the period of analysis to determine the Average Annual Habitat Units (AAHUs) available for each habitat type.

The change in AAHUs for each FWP scenario, compared to FWOP project conditions, provides a measure of anticipated impacts. A net gain in AAHUs indicates that the project is beneficial to the habitat being evaluated; a net loss of AAHUs indicates that the project is damaging to that habitat type.

Construction of the proposed levee segments would replace a FWOP functional marsh with a levee and borrow canal under FWP. Because the deep waters of navigation canals and major bayous are assumed to provide little if any habitat value, such waterbodies are typically excluded from the project area. Therefore, the HET assumed that the deep water of the FWP borrow canal would also be of little value, and hence, was excluded from the FWP project area. Since there would be no remaining habitat quantity or quality FWP, the final WVA results were taken as the sum of marsh + water FWOP AAHUs.

Although the WVA methodology is relatively easy to use, the study schedule did not allow for collection of field data for WVA inputs. Instead, best professional judgment (based on past site visits) was used to provide Variable 2 and Variable 4 inputs necessary to the WVA (percent submerged aquatic vegetation and percent shallow open water, respectively). Wetland acreage predictions discussed above were used to provide V1 values. However, one WVA assessed impacts to wetlands under forced drainage along Four Pointe Bayou. Those wetlands were assumed to experience no loss throughout the 70-year evaluation period.

Salinity modeling (conducted using 2004 input data) was assumed to represent baseline and construction year salinity values. The model outputs consisted of average subunit salinities at 15 minute intervals throughout the year for FWOP and for a FWP scenario with all floodgates and structures open year-round. Effects of short-term HNC Lock closures to reduce saltwater intrusion were not incorporated into the project scenarios modeled, and therefore were not reflected in FWP V5 values for the direct impact assessments. The output 15 minute salinity values were averaged as needed to provide V5 inputs. Predicted salinities under future with SLR conditions were not available within the study schedule. Hence, the HET had to assume that future salinities would remain the same as in 2004. For all levee segments, FWOP V6 was assumed to be unrestricted (V6 = 1.0). FWOP WVA variables used to assess direct impacts are listed in Tables A and B.

Table A. FWOP WVA variables for assessing direct impacts of 35-year protection features scheduled for immediate construction.

Levee Reach	Loss Subunit	Habitat Type	35-Year Levee Alternative Low SLR					35-Year Levee Alternative Medium SLR					35-Year Levee Alternative High SLR				
			TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-2	B13	INT	V1	81	79	0	0	V1	81	79	0	0	V1	81	79	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	80	80			V3-1	80	80			V3-1	80	80		
			V3-2	10	10			V3-2	10	10			V3-2	10	10		
			V3-3	10	10			V3-3	10	10			V3-3	10	10		
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	35	35	3	0	V4	35	35	3	0	V4	35	35	2	0
			V5	0	0	0	0	V5	0	0	0	0	V5	0	0	0	0
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6					V6					V6				
			V6	1.00	1.00	1.00	1.00	V6	1.00	1.00	1.00	1.00	V6	1.00	1.00	1.00	1.00
			TOT Ac	151	151	151	151	TOT Ac	151	151	151	151	TOT Ac	151	151	151	151
			% MF	0	0	0	0	% MF	0	0	0	0	% MF	0	0	0	0
			% INT	100	100	100	100	% INT	100	100	100	100	% INT	100	100	100	100

Levee Reach	Loss Subunit	Habitat Type	TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-1	B13	INT	V1	88	86	0	0	V1	88	86	0	0	V1	88	86	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	20	20	1	0	V4	20	20	1	0	V4	20	20	1	0
			V5	0	0	5	5	V5	0	0	5	5	V5	0	0	5	5
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6	0	0	1	1	V6	0	0	1	1	V6	0	0	1	1
			V6	1	1	1	1	V6	1	1	1	1	V6	1	1	1	1
			TOT Ac	76	76	76	76	TOT Ac	76	76	76	76	TOT Ac	76	76	76	76
			% MF	7	7	7	7	% MF	7	7	7	7	% MF	7	7	7	7
			% INT	93	93	93	93	% INT	93	93	93	93	% INT	93	93	93	93

Levee Reach	Loss Subunit	Habitat Type	TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-1	B13	BR	V1	82	80	0	0	V1	82	80	0	0	V1	82	80	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	60	60	1	0	V4	60	60	1	0	V4	60	60	1	0
			V5					V5					V5				
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6					V6					V6				
			V6	1	1	1	1	V6	1	1	1	1	V6	1	1	1	1
			TOT Ac	11	11	11	11	TOT Ac	11	11	11	11	TOT Ac	11	11	11	11

Table A. FWOP WVA variables for assessing direct impacts of 35-year protection features scheduled for immediate construction – continued.

			35-Year Levee Alternative					35-Year Levee Alternative					35-Year Levee Alternative				
Levee	Loss	Habitat	Low SLR					Medium SLR					High SLR				
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1		70
F-1	B15	BR	V1	77	77		53	V1	77	77		41	V1	77	77		1
			V2	0	0		0	V2	0	0		0	V2	0	0		0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2				30	V3-2				20	V3-2				
			V3-3	30	30		40	V3-3	30	30		40	V3-3	30	30		
			V3-4				30	V3-4				40	V3-4				
			V3-5					V3-5					V3-5				100
			V4	15	15		6	V4	15	15		5	V4	15	15		0
			V5					V5					V5				
			V5	5	5		5	V5	5	5		5	V5	5	5		5
			V6					V6					V6				
			V6	1	1		1	V6	1	1		1	V6	1	1		1
			TOT Ac	244	244		244	TOT Ac	244	244		244	TOT Ac	244	244		244
Levee	Loss	Habitat															
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	60	70
F-1	C21	BR	V1	70	70		32	V1	70	70		20	V1	70	70	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0		0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3				20	V3-3				15	V3-3				
			V3-4				80	V3-4				85	V3-4				
			V3-5					V3-5					V3-5			100	100
			V4	25	25		5	V4	25	25		3	V4	25	25	0	0
			V5					V5					V5				
			V5	8	8		8	V5	8	8		8	V5	8	8	8	8
			V6					V6					V6				
			V6	1	1		1	V6	1	1		1	V6	1	1	1	1
			TOT Ac	36	36		36	TOT Ac	36	36		36	TOT Ac	36	36	36	36
Levee	Loss	Habitat															
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	60	70
F-1 Ea.	C20	BR	V1	93	93		43	V1	93	93		27	V1	93	92	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0	0	0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2					V3-2					V3-2				
			V3-3	30	30		90	V3-3	30	30			V3-3	30	30		
			V3-4				10	V3-4				30	V3-4				
			V3-5					V3-5				70	V3-5			100	100
			V4	5	5		2	V4	5	5		0	V4	5	5	0	0
			V5					V5					V5				
			V5	6	6		6	V5	6	6		6	V5	6	6	6	6
			V6					V6					V6				
			V6	1	1		1	V6	1	1		1	V6	1	1	1	1
			TOT Ac	4	4		4	TOT Ac	4	4		4	TOT Ac	4	4	4	4

Table A. FWOP WVA variables for assessing direct impacts of 35-year protection features scheduled for immediate construction – continued.

			35-Year Levee Alternative					35-Year Levee Alternative					35-Year Levee Alternative				
Levee	Loss	Habitat	Low SLR					Medium SLR					High SLR				
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	59	70
G-1	C20	BR	V1	80	80		36	V1	80	80		22	V1	80	79	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0	0	0
			V3-1					V3-1					V3-1				
			V3-2	100	100			V3-2	100	100			V3-2	100	100		
			V3-3				50	V3-3				30	V3-3				
			V3-4				50	V3-4				70	V3-4				
			V3-5					V3-5					V3-5			100	100
			V4	5	5		1	V4	5	5		1	V4	5	5	0	0
			V5					V5					V5				
			V5	6	6		6	V5	6	6		6	V5	6	6	6	6
			V6					V6					V6				
			V6	1	1		1	V6	1	1		1	V6	1	1	1	1
			TOT Ac	2	2		2	TOT Ac	2	2		2	TOT Ac	2	2	2	2

Levee	Loss	Habitat															
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	59	70
G1	C21	BR	V1	77	76		34	V1	77	76		20	V1	77	76	0	0
			V2	5	5		0	V2	5	5		0	V2	5	5	0	0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2					V3-2					V3-2				
			V3-3	30	30			V3-3	30	30			V3-3	30	30		
			V3-4				40	V3-4				30	V3-4				
			V3-5				60	V3-5				70	V3-5			100	100
			V4	7	7		2	V4	7	7		1	V4	7	7	0	0
			V5					V5					V5				
			V5	8	8		8	V5	8	8		8	V5	8	8	8	8
			V6					V6					V6				
			V6	1	1		1	V6	1	1		1	V6	1	1	1	1
			TOT Ac	143	143		143	TOT Ac	143	143		143	TOT Ac	143	143	143	143

Levee	Loss	Habitat															
Reach	Subunit	Type	TY	TY	1		70	TY	0	1		70	TY	0	1	70	
G1	C19	FM	V1	73	73		73	V1	73	73		73	V1	73	73	73	
	Force		V2	10	10		10	V2	10	10		10	V2	10	10	10	
	Drained		V3-1	65	65		65	V3-1	65	65		65	V3-1	65	65	65	
			V3-2	35	35		35	V3-2	35	35		35	V3-2	35	35	35	
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5					V3-5					V3-5				
			V4	65	65		65	V4	65	65		65	V4	65	65	65	
			V5					V5					V5				
			V5	0	0		0	V5	0	0		0	V5	0	0	0	
			V6					V6					V6				
			V6	0	0		0	V6	0	0		0	V6	0	0	0	
			TOT Ac	19	19		19	TOT Ac	19	19		19	TOT Ac	19	19	19	
			% MF	100	100		100	% MF	100	100		100	% MF	100	100	100	
			% INT	0	0		0	% INT	0	0		0	% INT	0	0	0	

Table B. FWOP WVA variables for assessing direct impacts of 100-year protection features scheduled for immediate construction.

			100-Year Levee Alternative					100-Year Levee Alternative					100-Year Levee Alternative				
Levee	**Loss**	**Habitat**	**Low SLR**					**Medium SLR**					**High SLR**				
Reach	**Subunit**	**Type**	TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-2	**B13**	**INT**	V1	79	78	0	0	V1	79	78	0	0	V1	79	78	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	85	85			V3-1	85	85			V3-1	85	85		
			V3-2	7	7			V3-2	7	7			V3-2	7	7		
			V3-3	8	8			V3-3	8	8			V3-3	8	8		
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	25	25	1	0	V4	25	25	1	0	V4	25	25	1	0
			V5	0	0	5	5	V5	0	0	5	5	V5	0	0	5	5
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6	0.0	0.0	0.0	0.0	V6	0.0	0.0	0.0	0.0	V6	0.0	0.0	0.0	0.0
			V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	188	188	188	188	TOT Ac	188	188	188	188	TOT Ac	188	188	188	188
			% FM	0	0	0	0	% FM	0	0	0	0	% FM	0	0	0	0
			% INT	100	100	100	100	% INT	100	100	100	100	% INT	100	100	100	100

Levee	**Loss**	**Habitat**															
Reach	**Subunit**	**Type**	TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-1	**B13**	**INT**	V1	86	85	0	0	V1	86	85	0	0	V1	86	85	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	20	20	1	0	V4	20	20	1	0	V4	20	20	1	0
			V5	0	0	5	5	V5	0	0	5	5	V5	0	0	5	5
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6	0	0	1	1	V6	0	0	1	1	V6	0	0	1	1
			V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	85	85	85	85	TOT Ac	85	85	85	85	TOT Ac	85	85	85	85
			% FM	4	4	4	4	% FM	4	4	4	4	% FM	4	4	4	4
			% INT	96	96	96	96	% INT	96	96	96	96	% INT	96	96	96	96

Levee	**Loss**	**Habitat**															
Reach	**Subunit**	**Type**	TY	0	1	53	70	TY	0	1	47	70	TY	0	1	38	70
F-1	**B13**	**BR**	V1	81	80	0	0	V1	81	79	0	0	V1	81	79	0	0
			V2	0	0	0	0	V2	0	0	0	0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5			100	100	V3-5			100	100	V3-5			100	100
			V4	60	60	1	0	V4	60	60	1	0	V4	60	60	1	0
			V5					V5					V5				
			V5	5	5	5	5	V5	5	5	5	5	V5	5	5	5	5
			V6					V6					V6				
			V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	12	12	12	12	TOT Ac	12	12	12	12	TOT Ac	12	12	12	12

Table B. FWOP WVA variables for assessing direct impacts of 100-year protection features scheduled for immediate construction - continued.

			100-Year Levee Alternative					100-Year Levee Alternative					100-Year Levee Alternative				
Levee	Loss	Habitat	Low SLR					Medium SLR					High SLR				
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1		70
F-1	B15	BR	V1	76	75		52	V1	75	75		40	V1	75	75		1
			V2	0	0		0	V2	0	0		0	V2	0	0		0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2				30	V3-2				20	V3-2				
			V3-3	30	30		40	V3-3	30	30		40	V3-3	30	30		
			V3-4				30	V3-4				40	V3-4				
			V3-5					V3-5					V3-5				100
			V4	15	15		6	V4	15	15		5	V4	15	15		0
			V5					V5					V5				
			V5	5	5		5	V5	5	5		5	V5	5	5		5
			V6					V6					V6				
			V6	1.0	1.0		1.0	V6	1.0	1.0		1.0	V6	1.0	1.0		1.0
			TOT Ac	258	258		258	TOT Ac	258	258		258	TOT Ac	258	258		258
Levee	Loss	Habitat															
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	60	70
F-1	C21	BR	V1	86	85		38	V1	86	85		24	V1	86	85	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3				20	V3-3				15	V3-3				
			V3-4				80	V3-4				85	V3-4				
			V3-5					V3-5					V3-5			100	100
			V4	25	25		5	V4	25	25		3	V4	25	25	0	0
			V5					V5					V5				
			V5	8	8		8	V5	8	8		8	V5	8	8	8	8
			V6					V6					V6				
			V6	1.0	1.0		1.0	V6	1.0	1.0		1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	92	92		92	TOT Ac	92	92		92	TOT Ac	92	92	92	92
Levee	Loss	Habitat															
Reach	Subunit	Type	TY	0	1		70	TY	0	1		70	TY	0	1	60	70
F-1 Ea.	C20	BR	V1	93	93		43	V1	93	93		27	V1	93	92	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0	0	0
			V3-1	100	100			V3-1	100	100			V3-1	100	100		
			V3-2					V3-2					V3-2				
			V3-3				90	V3-3					V3-3				
			V3-4				10	V3-4				30	V3-4				
			V3-5					V3-5				70	V3-5			100	100
			V4	5	5		2	V4	5	5		0	V4	5	5	0	0
			V5					V5					V5				
			V5	6	6		6	V5	6	6		6	V5	6	6	6	6
			V6					V6					V6				
			V6	1.0	1.0		1.0	V6	1.0	1.0		1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	4	4		4	TOT Ac	4	4		4	TOT Ac	4	4	4	4

Table B. FWOP WVA variables for assessing direct impacts of 100-year protection features scheduled for immediate construction - continued.

Levee Reach	Loss Subunit	Habitat Type	100-Year Levee Alternative Low SLR					100-Year Levee Alternative Medium SLR					100-Year Levee Alternative High SLR				
			TY	0	1		70	TY	0	1		70	TY	0	1	59	70
G-1	C20	BR	V1	69	69		31	V1	69	69		19	V1	69	69	0	0
			V2	0	0		0	V2	0	0		0	V2	0	0	0	0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2					V3-2					V3-2				
			V3-3	30	30		50	V3-3	30	30		30	V3-3	30	30		
			V3-4				50	V3-4				70	V3-4				
			V3-5					V3-5					V3-5			100	100
			V4	10	10		2	V4	10	10		1	V4	10	10	0	0
			V5					V5					V5				
			V5	6	6		6	V5	6	6		6	V5	6	6	6	6
			V6					V6					V6				
			V6	1.0	1.0		1.0	V6	1.0	1.0		1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	4	4		4	TOT Ac	4	4		4	TOT Ac	4	4	4	4

Levee Reach	Loss Subunit	Habitat Type															
			TY	0	1		70	TY	0	1		70	TY	0	1	59	70
G1	C21	BR	V1	78	78		35	V1	78	77		21	V1	78	77	0	0
			V2	5	5		0	V2	5	5		0	V2	5	5	0	0
			V3-1	70	70			V3-1	70	70			V3-1	70	70		
			V3-2					V3-2					V3-2				
			V3-3	30	30			V3-3	30	30			V3-3	30	30		
			V3-4				40	V3-4				30	V3-4				
			V3-5				60	V3-5				70	V3-5			100	100
			V4	7	7		2	V4	7	7		1	V4	7	7	0	0
			V5					V5					V5				
			V5	8	8		8	V5	8	8		8	V5	8	8	8	8
			V6					V6					V6				
			V6	1.0	1.0		1.0	V6	1.0	1.0		1.0	V6	1.0	1.0	1.0	1.0
			TOT Ac	175	175		175	TOT Ac	175	175		175	TOT Ac	175	175	175	175

Levee Reach	Loss Subunit	Habitat Type															
			TY	0	1		70	TY	0	1		70	TY	0	1	70	
G1	C19	FM	V1	79	79		79	V1	79	79		79	V1	79	79	79	
	Force		V2	10	10		10	V2	10	10		10	V2	10	10	10	
	Drained		V3-1	65	65		65	V3-1	65	65		65	V3-1	65	65	65	
			V3-2	35	35		35	V3-2	35	35		35	V3-2	35	35	35	
			V3-3					V3-3					V3-3				
			V3-4					V3-4					V3-4				
			V3-5					V3-5					V3-5				
			V4	65	65		65	V4	65	65		65	V4	65	65	65	
			V5					V5					V5				
			V5	0	0		0	V5	0	0		0	V5	0	0	0	
			V6					V6					V6				
			V6	0.0	0.0		0.0	V6	0.0	0.0		0.0	V6	0.0	0.0	0.0	
			TOT Ac	33	33		33	TOT Ac	33	33		33	TOT Ac	33	33	33	
			% FM	100	100		100	% FM	100	100		100	% FM	100	100	100	
			% INT	0	0		0	% INT	0	0		0	% INT	0	0	0	

Indirect Impacts WVAs

In addition to direct construction impacts, project implementation might alter hydroperiod, salinity, and fish access to enclosed wetlands. Exterior wetlands could also be affected through project-induced salinity reductions and/or salinity increases. The HET examined hydrologic model results regarding project-induced water level changes. There was little if any change, and the HET assumed that those changes were not significant. Consequently, the HET did not attempt to assess impacts associated with project-induced changes in hydroperiod.

The HET also examined predicted salinity changes for subunits inside and outside the levee system. Because FWP salinities did not include the anticipated short-term HNC Lock closures to provide saltwater intrusion protection, the HET merged salinity outputs from a model run where the Lock was closed year-round with Plan 1 outputs (all gates open year-round) to create a Modified Plan 1 salinity output. Due to widely varying estimates of Lock closure duration, substantial uncertainty regarding Modified Plan 1 salinities, and the relatively minor change in predicted Modified Plan 1 salinities (which used a liberal estimate of lock closure duration), the HET decided that project-induced salinity reductions were too uncertain to quantify at this time. Predicted salinity increases were noted for marshes south of the Lock, during lock closure periods. However, the salinities remained within the optimal brackish marsh range according to WVA models. As a result, the HET decided not to assess benefits or impacts associated with project-induced salinity increases or decreases.

Because all Morganza floodgates and environmental structures would be closed only upon approach of a tropical storm, fisheries access interruptions would occur on average roughly 1 or 2 days per year. However, the duration of HNC Lock closures to reduce saltwater intrusion would likely be greater, and could result in quantifiable fish access interruptions. However, there were substantial uncertainties regarding the duration of lock closures. Additionally, effects of HNC Lock closures would potentially be reduced because the adjoining Bayou Grand Caillou floodgate would remain open to provide fish access. Lacking more definitive information on project-induced water exchange flux, the HET decided that the uncertainties were too great to propose project-induced reductions in fisheries access. As a result of its evaluations, the HET decided not to quantify any indirect impacts or indirect benefits associated with project implementation due to hydrology changes or fisheries access reductions

Mitgation WVAs.

To compensate for marsh losses associated with construction of levee reaches F1, F2, G1, the HNC Lock, and the Bayou Grand Caillou Floodgate, the HET evaluated several marsh creation projects under the medium SLR scenario. Construction impacts to fresh and intermediate marshes would be mitigated by marsh creation in the intermediate marshes of subunit B13 (open water areas south of Falgout Canal). Construction impacts to brackish marshes would be mitigated via marsh creation in the Felix Lake area (subunit B15 open water area immediately west of the HNC Lock). WVA variables used to quantify benefits of proposed marsh creation measures are provided in Table C.

Table C. WVA variables used to determine benefits of potential marsh creation mitigation projects.

			Medium SLR			Medium SLR					
Loss Subunit	**Habitat Type**		FWOP TY0	FWOP TY1	FWOP TY70	FWP TY1	FWP TY3	FWP TY5	FWP TY6	FWP TY32	FWP TY70
B13	**INT**	V1	0	0	0	10	25	97	96	77	19
		V2	0	0	0	0	0	0	0	0	0
		V3-1						50	100	77	
		V3-2								23	
		V3-3					100	50			
		V3-4									15
		V3-5	100	100	100	100					85
		V4	20	20	0	100	100	100	100	100	5
		V5	0	0	0	0	0	0	0	0	0
		V5	5	5	5	4	4	4	4	4	4
		V6									
		V6	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00
		TOT Ac	100	100	100	100	100	100	100	100	100
		% FM	0	0	0	0	0	0	0	0	0
		% INT	100	100	100	100	100	100	100	100	100

Loss Subunit	**Habitat Type**		FWOP TY0	FWOP TY1	FWOP TY70	FWP TY1	FWP TY3	FWP TY5	FWP TY6	FWP TY32	FWP TY70
B15	**BR**	V1	0	0	0	10	25	99	99	90	64
		V2	0	0	0	0	0	0	0	0	0
		V3-1	70	70				50	100	90	
		V3-2			20					10	25
		V3-3	30	30	40		100	50			75
		V3-4			40						
		V3-5				100					
		V4	60	60	0	100	100	100	100	100	70
		V5									
		V5	5	5	5	4	4	4	4	4	4
		V6									
		V6	1	1	1	0.00	0.00	1	1	1	1
		TOT Ac	500	500	500	500	500	500	500	500	500

Predicting Future Acreage of Marsh Creation Mitigation Projects

Mathematical formulas were developed for use in Excel spreadsheets to calculate net marsh creation project acres over time. A number of assumptions regarding loss rate reduction and the rate at which vegetation colonizes the created marsh platform were incorporated into those formulas and calculate the acres of functioning marsh for every year of the project life. To include the additional marsh loss under the medium and high SLR scenarios, the formulas under those scenarios were more complex than the formulas to calculate marsh creation acres under the low SLR scenario.

Marsh Creation Assumptions:

a) The created marsh loss rate is initially 50% of the loss rate of surrounding marshes provided that accretion above the created marsh platform is less than 10 inches.
b) The loss rate of created marsh will revert to background or baseline loss rates once 10 inches or more of post-construction accretion has occurred above the constructed marsh platform.
c) Given a study area average accretion rate of 0.91 cm/yr (Table D), and assuming an initial 3-yr settling period, 31 years is required to accrete 10 inches of soil above the created marsh platform. Prior to that time, loss rate is 50% of the background loss rate. Once 10 inches of soil has accreted, the loss rate reverts back to 100% of the background rate.
d) The FWOP condition is assumed to be all open water. Consequently, no formulas are needed to calculate FWOP marsh loss over time.
e) Functionality/vegetation of the created brackish marsh is per standard planted marsh protocols (TY1 = 10%, TY3=25%, TY5= 100%).
f) Functionality/vegetation of the created intermediate marsh is per standard planted marsh protocols (TY1= 10%, TY3=25%, TY5=100%).
g) Percent functionality for TY2 and TY4 is assumed to be midway between percent functionality values for the year before and after (TY2 is 18% and TY4 is 63%).
h) Loss of constructed marsh platform assumed to occur immediately after construction (at 50% of the marsh loss rate), independent of percent functionality/vegetation.

Formula inputs include:

1. AC – the acres of marsh to be created.
2. YC - year in which the marsh creation project is constructed.
3. MCLR - marsh creation loss rate in acres/yr. Calculated as (Polygon loss rate * Created acres)*50%. A loss rate is indicated by a negative value.
4. RCH - year FWP loss rate reverts from 50% of the polygon loss rate to 100% of the polygon loss rate. This year is calculated as the YC + 31 years.
5. YR – calendar year
6. SLR – additional loss rate due to increased sea level rise under the medium and high SLR scenarios (see Figure 5 and associated discussion above). SLR values increase each year after sea level rise acceleration begins in 2010.
7. PAC - prior year's marsh creation acreage.

Table D. Terrebonne Basin marsh soil accretion measurements from Jarvis (2010).

Location	**Time Period**	**Habitat Type**	**Method**	**(cm/yr)**	**Reference**
Deteriorating brackish	1989-1994	Brackish	137Cs	0.96	Nyman et al., 2006
Stable brackish	1989-1994	Brackish	137Cs	0.88	Nyman et al., 2006
N Billy Goat Bay	1963-1990	Brackish/saline	137Cs	1.06	Nyman et al., 1993
N Madison Bay	1963-1990	Brackish/saline	137Cs	1.33	Nyman et al., 1993
SE Madison Bay	1963-1990	Brackish/saline	137Cs	0.67	Nyman et al., 1993
W Madison Bay	1963-1990	Brackish/saline	137Cs	0.78	Nyman et al., 1993
Bay la Peur	1963-1990	Saline	137Cs	0.78	Nyman et al., 1993
Charles Theriot	1963-1990	Saline	137Cs	0.98	Nyman et al., 1993
Chitigue (upstream)	1963-1990	Saline	137Cs	1.22	Nyman et al., 1993
Chitigue (midstream)	1963-1990	Saline	137Cs	0.75	Nyman et al., 1993
Chitigue (downstream)	1963-1990	Saline	137Cs	0.98	Nyman et al., 1993
deMangue (upstream)	1963-1990	Saline	137Cs	0.94	Nyman et al., 1993
deMangue (midstream)	1963-1990	Saline	137Cs	1.28	Nyman et al., 1993
deMangue (downstream)	1963-1990	Saline	137Cs	0.56	Nyman et al., 1993
DuFrene	1963-1990	Saline	137Cs	0.55	Nyman et al., 1993
Fourleauge Bay	1975-1979	Saline	137Cs	0.66	Baumann et al., 1984
Grand Bayou	1963-1990	Saline	137Cs	1.04	Nyman et al., 1993
Lake Barre	1963-1990	Saline	137Cs	1.78	Nyman et al., 1993
Old Oyster Bayou	1992-2000	Saline	137Cs	0.48	Rybczyk and Cahoon, 2002
Stable saline	1989-1994	Saline	137Cs	0.59	Nyman et al., 2006
			Average =	**0.91**	

<u>FWP Excel Formula for Marsh Creation Acres – Low SLR Scenario</u>:

=IF(YR<YC,0,IF(YR=YC,(AC+MCLR)*0.1,IF(YR=YC+1,(AC+2*MCLR)*0.18,IF(YR=YC+2,(AC+3*MCLR)*0.25,IF(YR=YC+3,(AC+4*MCLR)*0.63,IF(YR=YC+4,(AC+5*MCLR),IF(YR<RCH,IF(PAC+MCLR<0,0,PAC+MCLR),IF(PAC+2*MCLR<0,0,PAC+2*MCLR)))))))).

<u>FWP Excel Formula for Marsh Creation Acres – Medium and High Scenario</u>:

=IF(YR<YC,0,IF(YR=YC,(AC+MCLR+SLR*AC)*0.1,IF(YR=YC+1,(AC+2*MCLR+SLR*AC)*0.18, IF(YR=YC+2,(AC+3*MCLR+SLR*AC)*0.25,IF(YR=YC+3,(AC+4*MCLR+SLR*AC)*0.63, IF(YR=YC+4,(AC+5*MCLR+SLR*AC),IF(YR<RCH,IF(PAC+MCLR+AC*SLR<0,0,PAC+MCLR+AC*SLR),IF(PAC+2MCLR+AC*SLR<0,0,PAC+MCLR+AC*SLR)))))))).

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Low SLR Scenario - Construction Impacts Summary by Reach and Habitat Type

3% Levee Reach	Fresh Hwds (acres)	Swamp (acres)	Marsh (acres)	Tidal Habitats Water* (acres)	INT Habi Marsh (acres)
Barrier	170.00	475.06	157.46	6.07	0.00
A	65.18	50.89	305.59	38.51	0.00
B	0.00	0.00	103.37	14.65	26.73
E-1	0.00	0.00	0.00	0.00	56.01
E-2	0.00	0.00	0.00	0.00	9.36
F-1	0.00	0.00	0.00	0.00	74.58
F-2	0.00	0.00	0.00	0.00	119.80
G-1	0.00	0.00	0.00	0.00	0.00
G-2	0.00	0.00	0.00	0.00	0.00
G-3	0.00	0.00	0.00	0.00	0.00
H-1	0.00	0.00	0.00	0.00	0.00
H-2	0.00	0.00	0.00	0.00	0.00
H-3	0.00	0.00	0.00	0.00	0.00
I-1	0.00	0.00	0.00	0.00	0.00
I-2	0.00	0.00	0.00	0.00	0.00
I-3	0.00	0.00	0.00	0.00	0.00
J-1	0.00	0.00	0.00	0.00	39.97
J-2	0.00	0.00	0.00	0.00	0.00
J-3	0.00	0.00	0.00	0.00	0.00
K	0.00	0.00	0.00	0.00	0.00
L	0.00	0.00	0.00	0.00	70.99
Total previous	235.18	525.95	566.42	59.23	397.44
Mitigation	$ 52,209,960	$ 58,380,450			
Monitoring	$ 658,504	$ 1,472,660			
LG	23.85	0.00	0.00	0.00	18.68
Mitigation	$ 5,294,700	$ -			
Monitoring	$ 66,780	$ -			
LL	171.06	35.66	85.67	0.00	0.00
Mitigation	$ 37,975,320	$ 3,958,260			
Monitoring	$ 478,968	$ 99,848			
TOTAL	430.09	561.61	652.09	59.23	416.12
Mitigation	$ 95,479,980	$ 62,338,710			
Monitoring	$ 1,204,252	$ 1,572,508			

Low SLR Scenario - Construction Impacts Summary by Reach and Habitat Type

1% Levee Reach	Fresh Hwds (acres)	Swamp (acres)	Marsh (acres)	Tidal Habitats Water* (acres)	INT Habi Marsh (acres)
Barrier	201.87	547.48	208.82	47.90	0.00

A	80.52	12.89	361.65	43.00	0.00
B	0.00	0.00	143.61	19.50	38.71
E-1	0.00	0.00	0.00	0.00	93.87
E-2	0.00	0.00	0.00	0.00	38.80
F-1	0.00	0.00	0.00	0.00	83.58
F-2	0.00	0.00	0.00	0.00	146.71
G-1	0.00	0.00	0.00	0.00	0.00
G-2	0.00	0.00	0.00	0.00	0.00
G-3	0.00	0.00	0.00	0.00	0.00
H-1	0.00	0.00	0.00	0.00	0.00
H-2	0.00	0.00	0.00	0.00	0.00
H-3	0.00	0.00	0.00	0.00	0.00
I-1	0.00	0.00	0.00	0.00	0.00
I-2	0.00	0.00	0.00	0.00	0.00
I-3	0.00	0.00	0.00	0.00	0.00
J-1	0.00	0.00	0.00	0.00	79.26
J-2	0.00	0.00	0.00	0.00	0.00
J-3	0.00	0.00	0.00	0.00	0.00
K	0.00	0.00	0.00	0.00	0.00
L	0.00	0.00	0.00	0.00	105.49
Total previous	282.39	560.37	714.08	110.40	586.42
Mitigation	$ 62,690,580	$ 62,201,070			
Monitoring	$ 790,692	$ 1,569,036			
LG	50.95	0.00	0.00	0.00	29.69
Mitigation	$ 11,310,900	$ -			
Monitoring	$ 142,660	$ -			
LL	186.92	38.92	88.72	0.00	0.00
Mitigation	$ 41,496,240	$ 4,320,120			
Monitoring	$ 523,376	$ 108,976			
TOTAL	520.26	599.29	802.80	110.40	616.11
Mitigation	$ 115,497,720	$ 66,521,190			
Monitoring	$ 1,456,728	$ 1,678,012			

Tidal	BR Habitats	Tidal	SAL	Tidal Habitats	Force Drainec
itats					
Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
112.30	0.00	0.00	0.00	0.00	0.00
135.57	0.00	0.00	0.00	0.00	0.00
154.43	0.00	0.00	0.00	0.00	0.00
15.69	216.70	67.68	0.00	0.00	0.00
31.64	0.00	0.00	0.00	0.00	0.00
0.00	110.80	34.73	0.00	0.00	14.06
0.00	0.00	0.00	28.53	63.27	0.00
0.00	0.00	0.00	33.40	16.20	0.00
0.00	0.00	0.00	83.43	53.35	0.00
0.00	0.00	0.00	138.14	71.95	0.00
0.00	0.00	0.00	73.74	192.95	0.00
0.00	74.36	73.47	0.39	0.20	0.00
0.00	0.00	0.00	66.00	95.15	0.00
0.00	0.00	0.00	69.15	109.55	0.00
151.21	0.00	0.00	1.56	10.33	0.00
0.00	25.86	177.14	24.51	157.09	17.25
0.00	0.00	0.00	17.65	89.83	0.00
0.00	88.84	413.09	0.00	0.00	0.00
35.22	70.80	101.57	0.00	0.00	0.00
636.06	587.36	867.68	536.50	859.87	31.31

0.70	0.00	0.00	0.00	0.00	0.00

0.00	0.00	0.00	0.00	0.00	0.00

636.76	587.36	867.68	536.50	859.87	31.31

Tidal	BR Habitats	Tidal	SAL	Tidal Habitats	Force Drainec
itats					
Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)
0.00	0.00	0.00	0.00	0.00	0.00

0.00	0.00	0.00	0.00	0.00	0.00
150.57	0.00	0.00	0.00	0.00	0.00
191.04	0.00	0.00	0.00	0.00	0.00
215.69	0.00	0.00	0.00	0.00	0.00
16.33	275.69	78.16	0.00	0.00	0.00
41.58	0.00	0.00	0.00	0.00	0.00
0.00	138.74	40.68	0.00	0.00	26.39
0.00	0.00	0.00	52.67	95.89	0.00
0.00	0.00	0.00	42.94	28.74	0.00
0.00	0.00	0.00	112.08	79.04	0.00
0.00	0.00	0.00	186.61	106.34	0.00
0.00	0.00	0.00	102.52	119.39	0.00
0.00	82.63	100.54	0.41	0.22	0.00
0.00	0.00	0.00	86.32	139.14	0.00
0.00	0.00	0.00	90.63	143.58	0.00
216.48	0.00	0.00	1.96	12.77	2.36
0.00	40.39	299.67	34.52	200.03	28.28
0.00	0.00	0.00	25.58	123.15	0.00
0.00	138.99	551.99	0.00	0.00	0.00
69.51	106.92	127.52	0.00	0.00	0.00
901.21	783.36	1,198.56	736.24	1,048.29	57.03
1.11	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
902.32	783.36	1,198.56	736.24	1,048.29	57.03

(non-tidal) Water (acres)	Total Tidal Water* acres	Total Tidal Marsh acres	Total Marsh (acres)	Total Mitigation
0.00	6.07	157.46	**157.46**	
0.00	38.51	305.59	**305.59**	
37.41	126.95	130.10	**130.10**	
0.00	135.57	56.01	**56.01**	
1.38	154.43	9.36	**9.36**	
0.00	83.37	291.28	**291.28**	
0.00	31.64	119.80	**119.80**	
5.10	34.73	110.80	**124.86**	
0.00	63.27	28.53	**28.53**	
0.00	16.20	33.40	**33.40**	
0.00	53.35	83.43	**83.43**	
0.00	71.95	138.14	**138.14**	
0.00	192.95	73.74	**73.74**	
0.15	73.67	74.75	**74.75**	
0.91	95.15	66.00	**66.00**	
0.00	109.55	69.15	**69.15**	
0.25	161.54	41.53	**41.53**	
1.29	334.23	50.37	**67.62**	
0.00	89.83	17.65	**17.65**	**Total Mitigation**
0.20	413.09	88.84	**88.84**	
5.36	136.79	141.79	**141.79**	
52.05	2,422.84	2,087.72	2,119.03	2,880.16
			$ 169,522,400	$ 280,112,810
			$ 5,933,284	$ 8,064,448
11.13	0.70	18.68	**18.68**	42.53
			$ 1,494,400	6,789,100.00
			$ 52,304	119,084.00
2.84	0.00	85.67	**85.67**	292.39
			$ 6,853,600	$ 48,787,180
			$ 239,876	$ 818,692
66.02	2,423.54	2,192.07	**2,223.38**	3,215.08
			$ 177,870,400	$ 335,689,090
			$ 6,225,464	$ 9,002,224

(non-tidal) Water (acres)	Total Tidal Water* acres	Total Tidal Marsh acres	Total Marsh (acres)
0.00	47.90	208.82	**208.82**

0.00	43.00	361.65	**361.65**	
38.95	170.07	182.32	**182.32**	
0.00	191.04	93.87	**93.87**	
4.16	215.69	38.80	**38.80**	
0.00	94.49	359.27	**359.27**	
0.00	41.58	146.71	**146.71**	
0.00	40.68	138.74	**165.13**	
0.00	95.89	52.67	**52.67**	
0.00	28.74	42.94	**42.94**	
0.00	79.04	112.08	**112.08**	
0.00	106.34	186.61	**186.61**	
0.00	119.39	102.52	**102.52**	
0.15	100.76	83.04	**83.04**	
0.91	139.14	86.32	**86.32**	
0.00	143.58	90.63	**90.63**	
0.76	229.25	81.22	**83.58**	
2.04	499.70	74.91	**103.19**	
4.34	123.15	25.58	**25.58**	**Total Mitigation**
0.37	551.99	138.99	**138.99**	
6.84	197.03	212.41	**212.41**	
58.52	3,258.45	2,820.10	2,877.13	3,719.89
			$ 230,170,400	$ 355,062,050
			$ 8,055,964	$ 10,415,692
18.39	1.11	29.69	**29.69**	80.64
			$ 2,375,200	13,686,100.00
			$ 83,132	225,792.00
2.84	0.00	88.72	**88.72**	314.56
			$ 7,097,600	$ 52,913,960
			$ 248,416	$ 880,768
79.75	3,259.56	2,938.51	**2,995.54**	4,115.09
			$ 239,643,200	$ 421,662,110
			$ 8,387,512	$ 11,522,252

Marsh Created with Constr$$	Net marsh	Total Mitigation after marsh created with Constr$$	3% Levee Reach
			Barrier
			A
			B
			E-1
			E-2
			F-1
			F-2
			G-1
			G-2
			G-3
			H-1
			H-2
			H-3
			I-1
			I-2
			I-3
			J-1
			J-2
			J-3
			K
			L
1,175.00	944.03	1,705.16	Total previous
	$ 75,522,400	$ 186,112,810	Mitigation
	$ 5,933,284	$ 8,064,448	Monitoring
		42.53	LG
		$ 6,789,100	Mitigation
		$ 119,084	Monitoring
		292.39	LL
		$ 48,787,180	Mitigation
		$ 818,692	Monitoring
		2,040.08	TOTAL
		$ 241,689,090	Mitigation
		$ 9,002,224	Monitoring

Marsh Created with Constr$$	Net marsh	Total Mitigation after marsh created with Constr$$
1,175.00	1,702.13	2,544.89
	$ 136,170,400	$ 261,062,050
	$ 8,055,964	$ 10,415,692
		80.64
		$ 13,686,100
		$ 225,792
		314.56
		$ 52,913,960
		$ 880,768
		2,940.09
		$ 327,662,110
		$ 11,522,252

1% Levee Reach
Barrier
A
B
E-1
E-2
F-1
F-2
G-1
G-2
G-3
H-1
H-2
H-3
I-1
I-2
I-3
J-1
J-2
J-3
K
L
Total previous
Mitigation
Monitoring
LG
Mitigation
Monitoring
LL
Mitigation
Monitoring
TOTAL
Mitigation
Monitoring

Intermediate SLR Scenario - Construction Impacts Summary by Reach and Habitat Type

Fresh			Tidal Habitats	INT Tidal Habitats	
Hwds (acres)	Swamp (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)
170.00	475.06	157.05	6.48	0.00	0.00
65.18	50.89	305.02	39.08	0.00	0.00
0.00	0.00	103.31	14.65	26.72	112.37
0.00	0.00	0.00	0.00	55.97	135.61
0.00	0.00	0.00	0.00	9.36	154.43
0.00	0.00	0.00	0.00	74.53	15.74
0.00	0.00	0.00	0.00	119.70	31.74
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	39.94	151.24
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	70.87	35.34
235.18	525.95	565.38	60.21	397.09	636.47
$ 52,209,960	$ 58,380,450				
$ 658,504	$ 1,472,660				
23.85	0.00	0.00	0.00	18.67	0.71
$ 5,294,700	$ -				
$ 66,780	$ -				
171.06	35.66	85.64	0.03	0.00	0.00
$ 37,975,320	$ 3,958,260				
$ 478,968	$ 99,848				
430.09	561.61	651.02	60.24	415.76	637.18
$ 95,479,980	$ 62,338,710				
$ 1,204,252	$ 1,572,508				

Intermediate SLR Scenario - Construction Impacts Summary by Reach and Habitat Type

Fresh			Tidal Habitats	INT Tidal Habitats	
Hwds	Swamp	Marsh	Water*	Marsh	Water*

(acres)	(acres)	(acres)	(acres)	(acres)	(acres)
201.87	547.48	208.70	48.02	0.00	0.00
80.52	12.89	361.46	43.19	0.00	0.00
0.00	0.00	143.53	19.51	38.69	150.66
0.00	0.00	0.00	0.00	93.80	191.11
0.00	0.00	0.00	0.00	38.77	215.72
0.00	0.00	0.00	0.00	83.52	16.39
0.00	0.00	0.00	0.00	146.59	41.70
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	79.20	216.54
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	105.40	69.60
282.39	560.37	713.69	110.72	585.97	901.73
$ 62,690,580	$ 62,201,070				
$ 790,692	$ 1,569,036				
50.95	0.00	0.00	0.00	29.67	1.13
$ 11,310,900	$ -				
$ 142,660	$ -				
186.92	38.92	88.69	0.03	0.00	0.00
$ 41,496,240	$ 4,320,120				
$ 523,376	$ 108,976				
520.26	599.29	802.38	110.75	615.64	902.86
$ 115,497,720	$ 66,521,190				
$ 1,456,728	$ 1,678,012				

BR Tidal Habitats		SAL Tidal Habitats		Force Drained (non-tidal)	
Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water (acres)
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	37.41
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	1.38
216.56	67.82	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
110.69	34.84	0.00	0.00	14.06	5.10
0.00	0.00	28.50	63.30	0.00	0.00
0.00	0.00	33.37	16.23	0.00	0.00
0.00	0.00	83.38	53.40	0.00	0.00
0.00	0.00	138.02	72.07	0.00	0.00
0.00	0.00	73.68	193.01	0.00	0.00
74.30	73.53	0.39	0.20	0.00	0.15
0.00	0.00	65.89	95.26	0.00	0.91
0.00	0.00	69.03	109.67	0.00	0.00
0.00	0.00	1.56	10.33	0.00	0.25
25.85	177.15	24.47	157.13	17.25	1.29
0.00	0.00	17.61	89.87	0.00	0.00
88.76	413.17	0.00	0.00	0.00	0.20
70.67	101.70	0.00	0.00	0.00	5.36
586.83	868.21	535.90	860.47	31.31	52.05

0.00	0.00	0.00	0.00	0.00	11.13

0.00	0.00	0.00	0.00	0.00	2.84

586.83	868.21	535.90	860.47	31.31	66.02

BR Tidal Habitats		SAL Tidal Habitats		Force Drained (non-tidal)	
Marsh	Water*	Marsh	Water*	Marsh	Water

(acres)	(acres)	(acres)	(acres)	(acres)	(acres)
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	38.95
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	4.16
275.52	78.33	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
138.60	40.82	0.00	0.00	26.39	0.00
0.00	0.00	52.61	95.95	0.00	0.00
0.00	0.00	42.89	28.79	0.00	0.00
0.00	0.00	111.99	79.13	0.00	0.00
0.00	0.00	186.44	106.51	0.00	0.00
0.00	0.00	102.43	119.48	0.00	0.00
82.56	100.61	0.41	0.22	0.00	0.15
0.00	0.00	86.18	139.28	0.00	0.91
0.00	0.00	90.47	143.74	0.00	0.00
0.00	0.00	1.96	12.77	2.36	0.76
40.36	299.70	34.46	200.09	28.28	2.04
0.00	0.00	25.53	123.20	0.00	4.34
138.88	552.10	0.00	0.00	0.00	0.37
106.81	127.63	0.00	0.00	0.00	6.84
782.73	1,199.19	735.37	1,049.16	57.03	58.52
0.00	0.00	0.00	0.00	0.00	18.39
0.00	0.00	0.00	0.00	0.00	2.84
782.73	1,199.19	735.37	1,049.16	57.03	79.75

Total Tidal Water* acres	Total Tidal Marsh acres	Total Marsh (acres)		
6.48	157.05	**157.05**		
39.08	305.02	**305.02**		
127.02	130.03	**130.03**		
135.61	55.97	**55.97**		
154.43	9.36	**9.36**		
83.56	291.09	**291.09**		
31.74	119.70	**119.70**		
34.84	110.69	**124.75**		
63.30	28.50	**28.50**		
16.23	33.37	**33.37**		
53.40	83.38	**83.38**		
72.07	138.02	**138.02**		
193.01	73.68	**73.68**		
73.73	74.69	**74.69**		
95.26	65.89	**65.89**		
109.67	69.03	**69.03**		
161.57	41.50	**41.50**		
334.28	50.32	**67.57**	**3% alternative**	
89.87	17.61	**17.61**	**Total Mitigation**	**Marsh**
413.17	88.76	**88.76**		**Created**
137.04	141.54	**141.54**		**with Constr$$**
2,425.36	2,085.20	2,116.51	2,877.64	**1,175.00**
		$ 169,320,800	$ 279,911,210	
		$ 5,926,228	$ 8,057,392	
0.71	18.67	**18.67**	42.52	
		$ 1,493,600	6,788,300.00	
		$ 52,276	119,056.00	
0.03	85.64	**85.64**	292.36	
		$ 6,851,200	$ 48,784,780	
		$ 239,792	$ 818,608	
2,426.10	2,189.51	**2,220.82**	3,212.52	
		$ 177,665,600	$ 335,484,290	
		$ 6,218,296	$ 8,995,056	

Total Tidal Water*	Total Tidal Marsh	Total Marsh

acres	acres	(acres)		
48.02	208.70	**208.70**		
43.19	361.46	**361.46**		
170.17	182.22	**182.22**		
191.11	93.80	**93.80**		
215.72	38.77	**38.77**		
94.72	359.04	**359.04**		
41.70	146.59	**146.59**		
40.82	138.60	**164.99**		
95.95	52.61	**52.61**		
28.79	42.89	**42.89**		
79.13	111.99	**111.99**		
106.51	186.44	**186.44**		
119.48	102.43	**102.43**		
100.83	82.97	**82.97**		
139.28	86.18	**86.18**		
143.74	90.47	**90.47**		
229.31	81.16	**83.52**		
499.79	74.82	**103.10**	**1 % alternative**	
123.20	25.53	**25.53**	**Total Mitigation**	**Marsh**
552.10	138.88	**138.88**		**Created**
197.23	212.21	**212.21**		**with Constr$$**
3,260.79	2,817.76	2,874.79	3,717.55	**1,175.00**
		$ 229,983,200	$ 354,874,850	
		$ 8,049,412	$ 10,409,140	
1.13	29.67	**29.67**	80.62	
		$ 2,373,600	13,684,500.00	
		$ 83,076	225,736.00	
0.03	88.69	**88.69**	314.53	
		$ 7,095,200	$ 52,911,560	
		$ 248,332	$ 880,684	
3,261.95	2,936.12	2,993.15	4,112.70	
		$ 239,452,000	$ 421,470,910	
		$ 8,380,820	$ 11,515,560	

Net marsh	Total Mitigation after marsh created with Constr$$
941.51	1,702.64
$ 75,320,800	$ 185,911,210
$ 5,926,228	$ 8,057,392
	42.52
	$ 6,788,300
	$ 119,056
	292.36
	$ 48,784,780
	$ 818,608
	2,037.52
	$ 241,484,290
	$ 8,995,056

High SLR Scenario

3% Levee Reach	Fresh Hwds (acres)
Barrier	170.00
A	65.18
B	0.00
E-1	0.00
E-2	0.00
F-1	0.00
F-2	0.00
G-1	0.00
G-2	0.00
G-3	0.00
H-1	0.00
H-2	0.00
H-3	0.00
I-1	0.00
I-2	0.00
I-3	0.00
J-1	0.00
J-2	0.00
J-3	0.00
K	0.00
L	0.00
Total previous	235.18
Mitigation	$ 52,209,960
Monitoring	$ 658,504
LG	23.85
Mitigation	$ 5,294,700
Monitoring	$ 66,780
LL	171.06
Mitigation	$ 37,975,320
Monitoring	$ 478,968
TOTAL	430.09
Mitigation	$ 95,479,980
Monitoring	$ 1,204,252

High SLR Scenario

1% Levee Reach	Fresh Hwds (acres)
Barrier	201.87

Net marsh	Total Mitigation after marsh created with Constr$$
1,699.79	2,542.55
$ 135,983,200	$ 260,874,850
$ 8,049,412	$ 10,409,140
	80.62
	$ 13,684,500
	$ 225,736
	314.53
	$ 52,911,560
	$ 880,684
	2,937.70
	$ 327,470,910
	$ 11,515,560

A	80.52
B	0.00
E-1	0.00
E-2	0.00
F-1	0.00
F-2	0.00
G-1	0.00
G-2	0.00
G-3	0.00
H-1	0.00
H-2	0.00
H-3	0.00
I-1	0.00
I-2	0.00
I-3	0.00
J-1	0.00
J-2	0.00
J-3	0.00
K	0.00
L	0.00
Total previous	282.39
Mitigation	$ 62,690,580
Monitoring	$ 790,692
LG	50.95
Mitigation	$ 11,310,900
Monitoring	$ 142,660
LL	186.92
Mitigation	$ 41,496,240
Monitoring	$ 523,376
TOTAL	520.26
Mitigation	$ 115,497,720
Monitoring	$ 1,456,728

- Construction Impacts Summary by Reach and Habitat Type

		Tidal Habitats	INT Habitats	Tidal	BR Habi
Swamp (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)
475.06	155.71	7.82	0.00	0.00	0.00
50.89	303.14	40.96	0.00	0.00	0.00
0.00	103.12	14.68	26.67	112.58	0.00
0.00	0.00	0.00	55.82	135.76	0.00
0.00	0.00	0.00	9.34	154.45	0.00
0.00	0.00	0.00	74.34	15.93	216.14
0.00	0.00	0.00	119.38	32.06	0.00
0.00	0.00	0.00	0.00	0.00	110.34
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	74.11
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	39.85	151.33	0.00
0.00	0.00	0.00	0.00	0.00	25.78
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	88.51
0.00	0.00	0.00	70.47	35.74	70.18
525.95	561.97	63.46	395.87	637.85	585.06
$ 58,380,450					
$ 1,472,660					
0.00	0.00	0.00	18.63	0.75	0.00
$ -					
$ -					
35.66	85.56	0.11	0.00	0.00	0.00
$ 3,958,260					
$ 99,848					
561.61	647.53	63.57	414.50	638.60	585.06
$ 62,338,710					
$ 1,572,508					

- Construction Impacts Summary by Reach and Habitat Type

		Tidal Habitats	INT Habitats	Tidal	BR Habi
Swamp (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)
547.48	208.32	48.40	0.00	0.00	0.00

12.89	360.85	43.80	0.00	0.00	0.00
0.00	143.28	19.54	38.61	150.96	0.00
0.00	0.00	0.00	93.55	191.36	0.00
0.00	0.00	0.00	38.68	215.81	0.00
0.00	0.00	0.00	83.32	16.59	274.98
0.00	0.00	0.00	146.19	42.10	0.00
0.00	0.00	0.00	0.00	0.00	138.16
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	82.35
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	79.02	216.72	0.00
0.00	0.00	0.00	0.00	0.00	40.26
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	138.47
0.00	0.00	0.00	105.09	69.91	106.43
560.37	712.45	111.74	584.46	903.45	780.65
$ 62,201,070					
$ 1,569,036					
0.00	0.00	0.00	29.61	1.19	0.00
$ -					
$ -					
38.92	88.60	0.12	0.00	0.00	0.00
$ 4,320,120					
$ 108,976					
599.29	801.05	111.86	614.07	904.64	780.65
$ 66,521,190					
$ 1,678,012					

Tidal	SAL	Tidal			Total
itats	Habitats		Force Drained	(non-tidal)	Tidal
Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water (acres)	Water* acres
0.00	0.00	0.00	0.00	0.00	7.82
0.00	0.00	0.00	0.00	0.00	40.96
0.00	0.00	0.00	0.00	37.41	127.26
0.00	0.00	0.00	0.00	0.00	135.76
0.00	0.00	0.00	0.00	1.38	154.45
68.24	0.00	0.00	0.00	0.00	84.17
0.00	0.00	0.00	0.00	0.00	32.06
35.19	0.00	0.00	14.06	5.10	35.19
0.00	28.41	63.39	0.00	0.00	63.39
0.00	33.25	16.35	0.00	0.00	16.35
0.00	83.18	53.60	0.00	0.00	53.60
0.00	137.62	72.47	0.00	0.00	72.47
0.00	73.47	193.22	0.00	0.00	193.22
73.72	0.39	0.20	0.00	0.15	73.92
0.00	65.53	95.62	0.00	0.91	95.62
0.00	68.65	110.05	0.00	0.00	110.05
0.00	1.55	10.34	0.00	0.25	161.67
177.22	24.33	157.27	17.25	1.29	334.49
0.00	17.49	89.99	0.00	0.00	89.99
413.42	0.00	0.00	0.00	0.20	413.42
102.19	0.00	0.00	0.00	5.36	137.93
869.98	533.87	862.50	31.31	52.05	2,433.79
0.00	0.00	0.00	0.00	11.13	0.75
0.00	0.00	0.00	0.00	2.84	0.11
869.98	533.87	862.50	31.31	66.02	2,434.65

Tidal					Total
itats	SAL	Tidal Habitats	Force Drained	(non-tidal)	Tidal
Water* (acres)	Marsh (acres)	Water* (acres)	Marsh (acres)	Water (acres)	Water* acres
0.00	0.00	0.00	0.00	0.00	48.40

0.00	0.00	0.00	0.00	0.00	43.80
0.00	0.00	0.00	0.00	38.95	170.50
0.00	0.00	0.00	0.00	0.00	191.36
0.00	0.00	0.00	0.00	4.16	215.81
78.87	0.00	0.00	0.00	0.00	95.46
0.00	0.00	0.00	0.00	0.00	42.10
41.26	0.00	0.00	26.39	0.00	41.26
0.00	52.44	96.12	0.00	0.00	96.12
0.00	42.72	28.96	0.00	0.00	28.96
0.00	111.75	79.37	0.00	0.00	79.37
0.00	185.91	107.04	0.00	0.00	107.04
0.00	102.13	119.78	0.00	0.00	119.78
100.82	0.41	0.22	0.00	0.15	101.04
0.00	85.71	139.75	0.00	0.91	139.75
0.00	89.97	144.24	0.00	0.00	144.24
0.00	1.95	12.78	2.36	0.76	229.50
299.80	34.26	200.29	28.28	2.04	500.09
0.00	25.36	123.37	0.00	4.34	123.37
552.51	0.00	0.00	0.00	0.37	552.51
128.01	0.00	0.00	0.00	6.84	197.92
1,201.27	732.61	1,051.92	57.03	58.52	3,268.38
0.00	0.00	0.00	0.00	18.39	1.19
0.00	0.00	0.00	0.00	2.84	0.12
1,201.27	732.61	1,051.92	57.03	79.75	3,269.69

Total Tidal Marsh acres	Total Marsh (acres)	Total Mitigation	Marsh Created with Constr$$	Net marsh
155.71	**155.71**			
303.14	**303.14**			
129.79	**129.79**			
55.82	**55.82**			
9.34	**9.34**			
290.48	**290.48**			
119.38	**119.38**			
110.34	**124.40**			
28.41	**28.41**			
33.25	**33.25**			
83.18	**83.18**			
137.62	**137.62**			
73.47	**73.47**			
74.50	**74.50**			
65.53	**65.53**			
68.65	**68.65**			
41.40	**41.40**			
50.11	**67.36**			
17.49	**17.49**			
88.51	**88.51**			
140.65	**140.65**			
2,076.77	2,108.08	2,869.21	**1,175.00**	933.08
	$ 168,646,400	$ 279,236,810		$ 74,646,400
	$ 5,902,624	$ 8,033,788		$ 5,902,624
18.63	**18.63**	42.48		
	$ 1,490,400	6,785,100.00		
	$ 52,164	118,944.00		
85.56	**85.56**	292.28		
	$ 6,844,800	$ 48,778,380		
	$ 239,568	$ 818,384		
2,180.96	**2,212.27**	3,203.97		
	$ 176,981,600	$ 334,800,290		
	$ 6,194,356	$ 8,971,116		

Total Tidal Marsh acres	Total Marsh (acres)
208.32	**208.32**

360.85	**360.85**			
181.89	**181.89**			
93.55	**93.55**			
38.68	**38.68**			
358.30	**358.30**			
146.19	**146.19**			
138.16	**164.55**			
52.44	**52.44**			
42.72	**42.72**			
111.75	**111.75**			
185.91	**185.91**			
102.13	**102.13**			
82.76	**82.76**			
85.71	**85.71**			
89.97	**89.97**			
80.97	**83.33**			
74.52	**102.80**			
25.36	**25.36**	**Total Mitigation**	**Marsh Created with Constr$$**	Net marsh
138.47	**138.47**			
211.52	**211.52**			
2,810.17	2,867.20	3,709.96	**1,175.00**	1,692.20
	$ 229,376,000	$ 354,267,650		$ 135,376,000
	$ 8,028,160	$ 10,387,888		$ 8,028,160
29.61	**29.61**	80.56		
	$ 2,368,800	13,679,700.00		
	$ 82,908	225,568.00		
88.60	**88.60**	314.44		
	$ 7,088,000	$ 52,904,360		
	$ 248,080	$ 880,432		
2,928.38	**2,985.41**	4,104.96		
	$ 238,832,800	$ 420,851,710		
	$ 8,359,148	$ 11,493,888		

Total Mitigation after marsh created with Constr$$
1,694.21
$ 185,236,810
$ 8,033,788
42.48
$ 6,785,100
$ 118,944
292.28
$ 48,778,380
$ 818,384
2,028.97
$ 240,800,290
$ 8,971,116

Total Mitigation after marsh created with Constr$$
2,534.96
$ 260,267,650
$ 10,387,888
80.56
$ 13,679,700
$ 225,568
314.44
$ 52,904,360
$ 880,432
2,929.96
$ 326,851,710
$ 11,493,888

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

REPLY TO
ATTENTION OF

CECW-P

28 February 2012

MEMORANDUM FOR Director, National Ecosystem Restoration Planning Center of Expertise (ECO-PCX)

SUBJECT: Wetland Value Assessment Models – Coastal Marsh Module Version 1.0 – Approval for Use

1. The Coastal Marsh Community model is one of seven WVA community models that were developed by the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Environmental Work Group. Based on information provided by the ECO-PCX, it is the understanding of the HQUSACE Model Certification Panel that this model will be used on the following projects over the next five years:

a. MRGO Ecosystem Restoration
b. Barataria Basin Barrier Shoreline
c. Lake Pontchatrain and Vicinity Hurricane Storm Damage Risk Reduction System (HSDRRS) Mitigation
d. West Bank and Vicinity HSDRRS Mitigation
e. HSDRRS IERS –total number unknown
f. Louisiana Coastal Area (LCA) 4 Davis Pond Modification
g. LCA4 Modification to Caernarvon
h. LCA4 Point Au Fer Island
i. LCA4 Caillou Lake Land Bridge
j. LCA Myrtle Grove
k. LCA White Ditch PED
l. LCA Mississippi River Hydrodynamic and Delta Management
m. LCA Caernarvon
n. Larose to Golden Meadow (LGM) Post-Authorization Change (PAC) Study
o. Larose to Golden Meadow Intracoastal Floodwall Reach 2b (LGM-022C).
p. Larose to Golden Meadow Intracoastal Floodwall Reach 2a (LGM-022B).
q. Larose to Golden Meadow C-North Highway 24 Relocation (LGM-001C).
r. Baptiste Collette Bayou Deepening study
s. Barataria Bay Waterway (CAP 204)
t. Buras Marina (CAP 206)
u. Calcasieu River and Pass (CAP 204)
v. Calcasieu Lock Replacement
w. Morganza to the Gulf PAC
x. Morganza to the Gulf Supplemental NEPA documents –total number unknown
y. Southwest Coastal
z. Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) – West Bay Closure
aa. Houma Navigation Canal Deepening
bb. West Shore Lake Pontchartrain Hurricane & Flood Risk Reduction
cc. LCA Terrebonne Basin Barrier Shoreline Restoration
dd. LCA Demonstration Projects Grand Isle and Vicinity Project
ee. CAP 103 Grand Isle Highway 1 Shoreline Stabilization
ff. Donalsonville to the Gulf
gg. NOV Plaquemines Parish
hh. NFL Plaquemines Parish

2. Version 1.0 of the Coastal Marsh Community model is approved for use for the above projects. This approval for use is based on the decision of the HQUSACE Model Certification Panel which considered the ECO-PCX assessment of the model. Adequate technical reviews have been accomplished and the model meets the certification criteria contained in EC 1105-2-412. As indicated by the ECO-PCX, there are a number of unresolved issues related to the form of suitability graphs for Variables 1, 2 and 3 and the aggregation methods used to combine the marsh habitat units and open water habitat units for each sub-model. To increase the understanding of the sensitivity of the model to the unresolved issues and the impact the model differences may have on decision-making, the ECO-PCX is to work with the project delivery teams to conduct sensitivity analyses for each application of the marsh models. A summary of the sensitivity analyses must be presented in the project documentation and Agency Technical Review teams must be charged with reviewing the adequacy and findings of the sensitivity analyses.

3. It is expected that compiliation of the findings of the multiple sensitivity analyses will lead to updates and improvements of the model. As such, version control is imperative. The PCX must ensure that project delivery teams are are utilizing the most appropriate version of the model for their analyses and that they are properly identifiying the version of the model being used.

APPLICABILITY: This approval for use expires 28 February 2017 and is limited to the above studies with the caveat that updated versions of the model be used if appropriate.

Harry E Kitch

HARRY E. KITCH, P.E.
Deputy Chief, Planning and Policy Division
Directorate of Civil Works

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

REPLY TO
ATTENTION OF

CECW-P

8 November 2011

MEMORANDUM FOR Director, National Ecosystem Restoration Planning Center of Expertise (ECO-PCX)

SUBJECT: Wetland Value Assessment (WVA) Models – Barrier Headland, Barrier Island, Bottomland Hardwood, Coastal Chenier, and Swamp Models - Model Approval.

1. The HQUSACE Model Certification Panel has reviewed the externally-developed WVA in accordance with EC 1105-2-412 and has determined that the Barrier Headland, Barrier Island, Bottomland Hardwood, Coastal Chenier, and Swamp Models and their accompanying documentation are sufficient to approve the models for regional use. The WVA models were developed by the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Environmental Work Group, an interagency team including US Fish and Wildlife Service, National Marine Fisheries Services, US Environmental Protection Agency, Natural Resources Conservation Service, USACE, and Louisiana Office of Coastal Protection and Restoration.

2. The models were initially developed in the 1990s and have been periodically revised and updated by the CWPPRA Environmental Work Group which is led by the US Fish and Wildlife Service. Models developed by non-Federal government entities, NGOs, or academic institutions which are proposed as part of a Corps planning study can be approved for use based on an assessment of the proponent's documentation demonstrating that the model satisfies the certification criteria.

3. Battelle Memorial Institute conducted an independent review of the procedural manual, community models and associated spreadsheets to assess the technical quality and usability of the model. A number of high significance concerns with the documentation of the model were raised. Further coordination with the ECO-PCX clarified that the ECO-PCX had conducted a detailed review of the model documentation and model spreadsheets to evaluate the degree to which revisions were made based on the model review comments and responses. Adequate technical reviews have been accomplished. This approval is based on the decision of the HQUSACE Model Certification Panel which considered the ECO-PCX assessments of the models.

APPLICABILITY: This approval for use is limited to applicable projects in coastal Louisiana and eastern Texas..

HARRY E. KITCH, P.E.
Deputy Chief, Planning and Policy Division
Directorate of Civil Works

Appendix G

MAPBOOK

Legend

- PumpStations
- Centerline
- Right of Way
- NWR or WMA
- Mitigation Area
- Borrow Pits
- 1 Sluice Gate, 6 Box Culverts — Environmental Water Control Structure

1% Annual Exceedance Probability Storm Surge Risk Reduction System Alternative

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

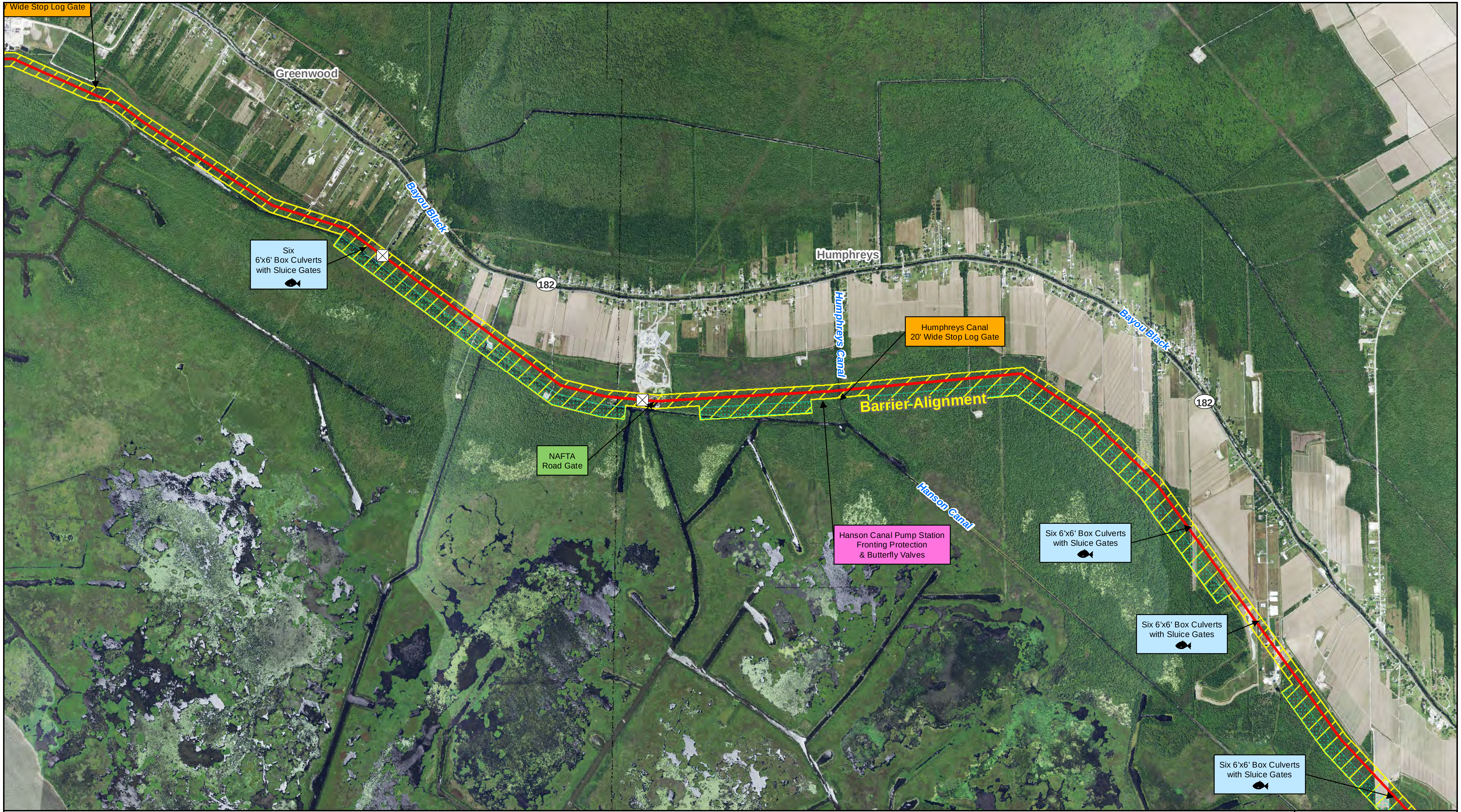
2010 USDA-FSA-APFO NAIP MrSID Mosaics: Lafourche and Terrebonne Parishes

N

0 1,200 2,400 Feet

GEC
Gulf Engineers & Consultants

Figure: 01 of 14
Date: June 2012
Scale: 1:28,800
Source: USDA/GEC
Map ID: 273160010-3004



Legend

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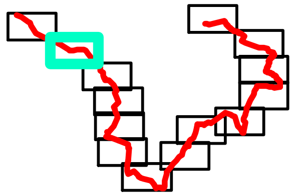

N

0 1,200 2,400 Feet

GEC
Gulf Engineers & Consultants

Figure: 02 of 14
Date: June 2012
Scale: 1:28,800
Source: USDA/GEC
Map ID: 273160010-3004

Legend

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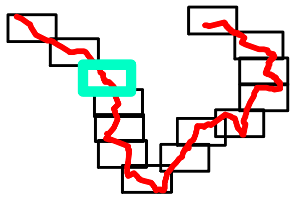

N

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GEC
Gulf Engineers & Consultants

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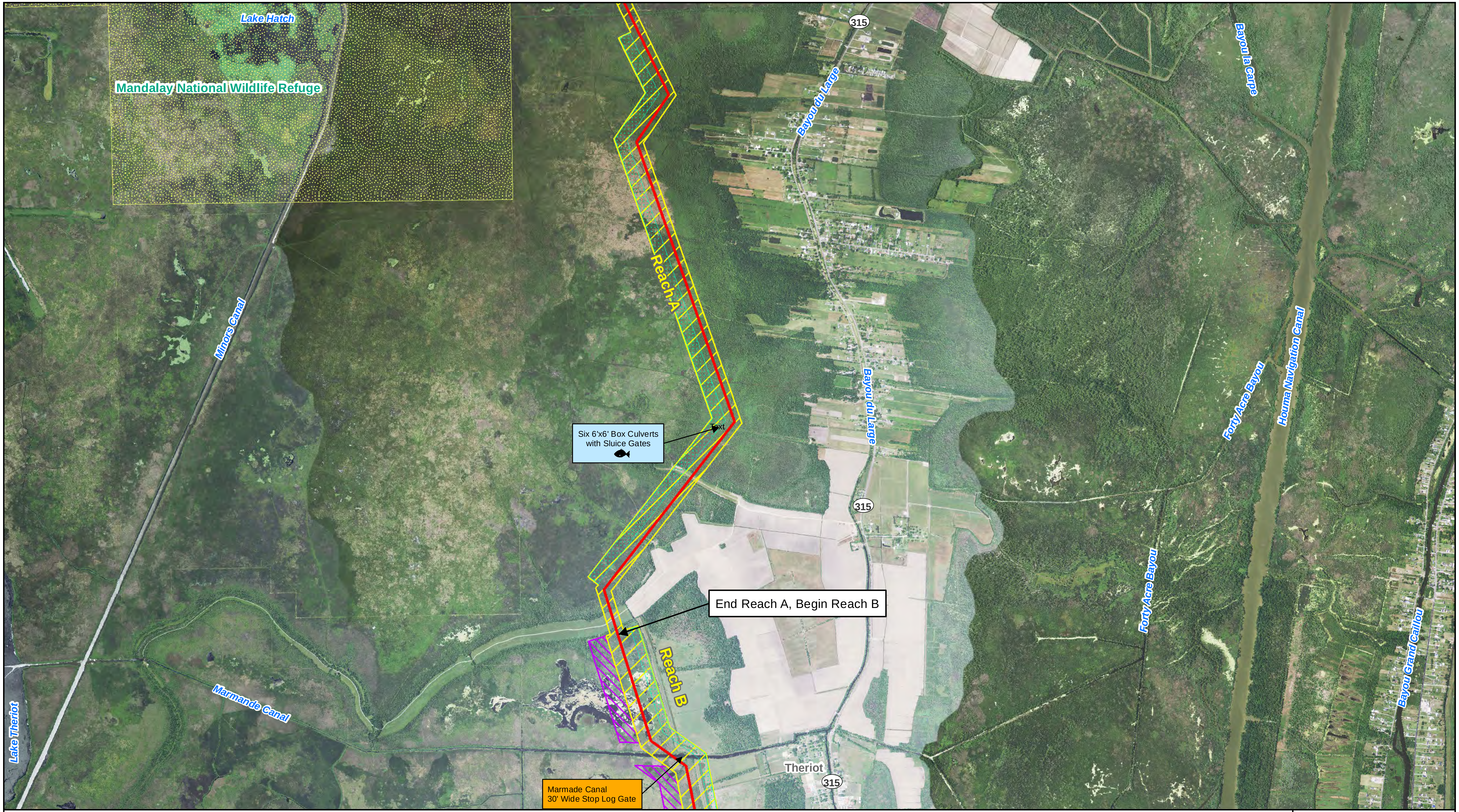

Legend

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N

0 1,200 2,400 Feet

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Gulf Engineers & Consultants

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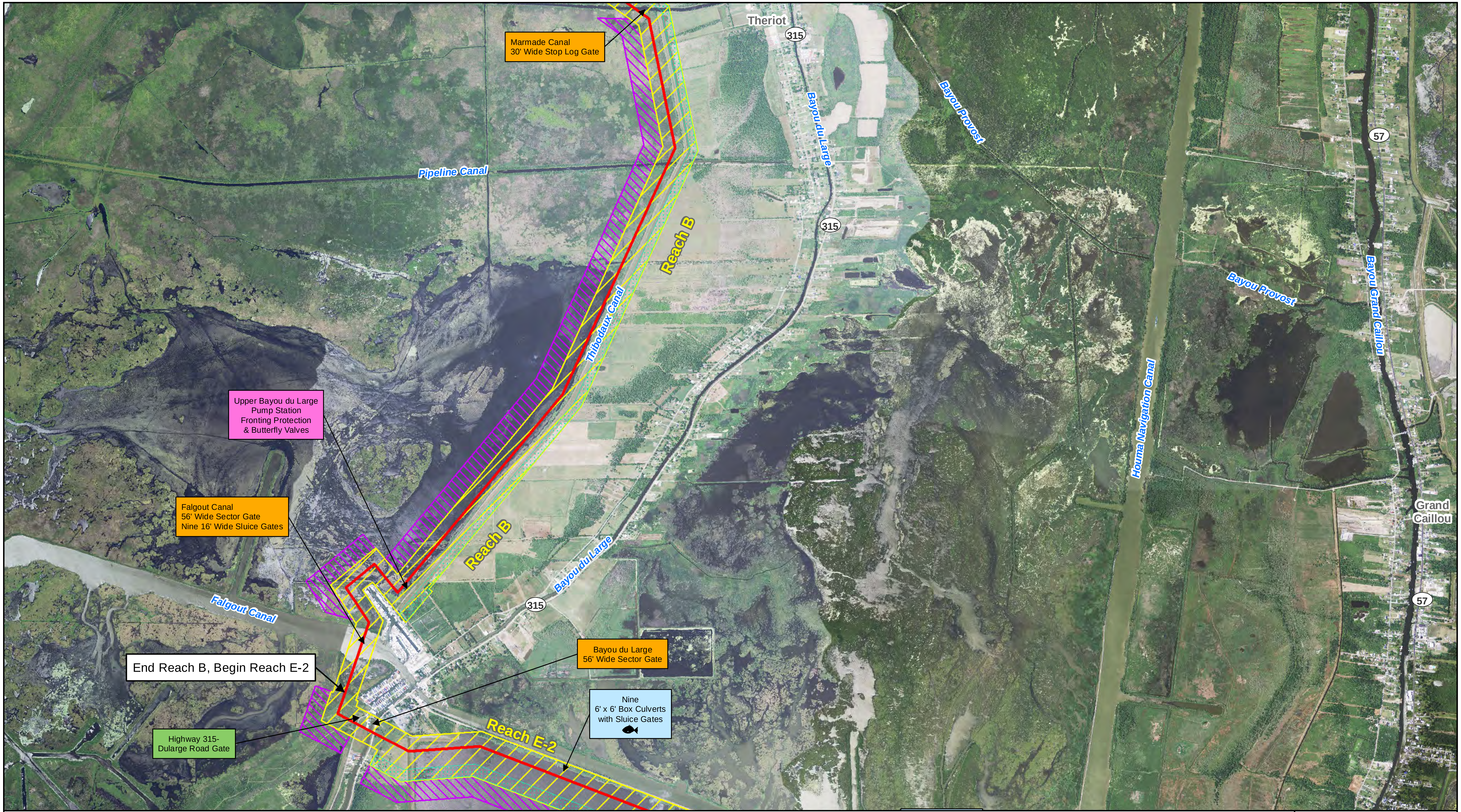

Legend

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Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

2010 USDA-FSA-APFO NAIP MrSID Mosaics: Lafourche and Terrebonne Parishes

N

0 1,200 2,400 Feet

GEC Gulf Engineers & Consultants

Figure: 05 of 14
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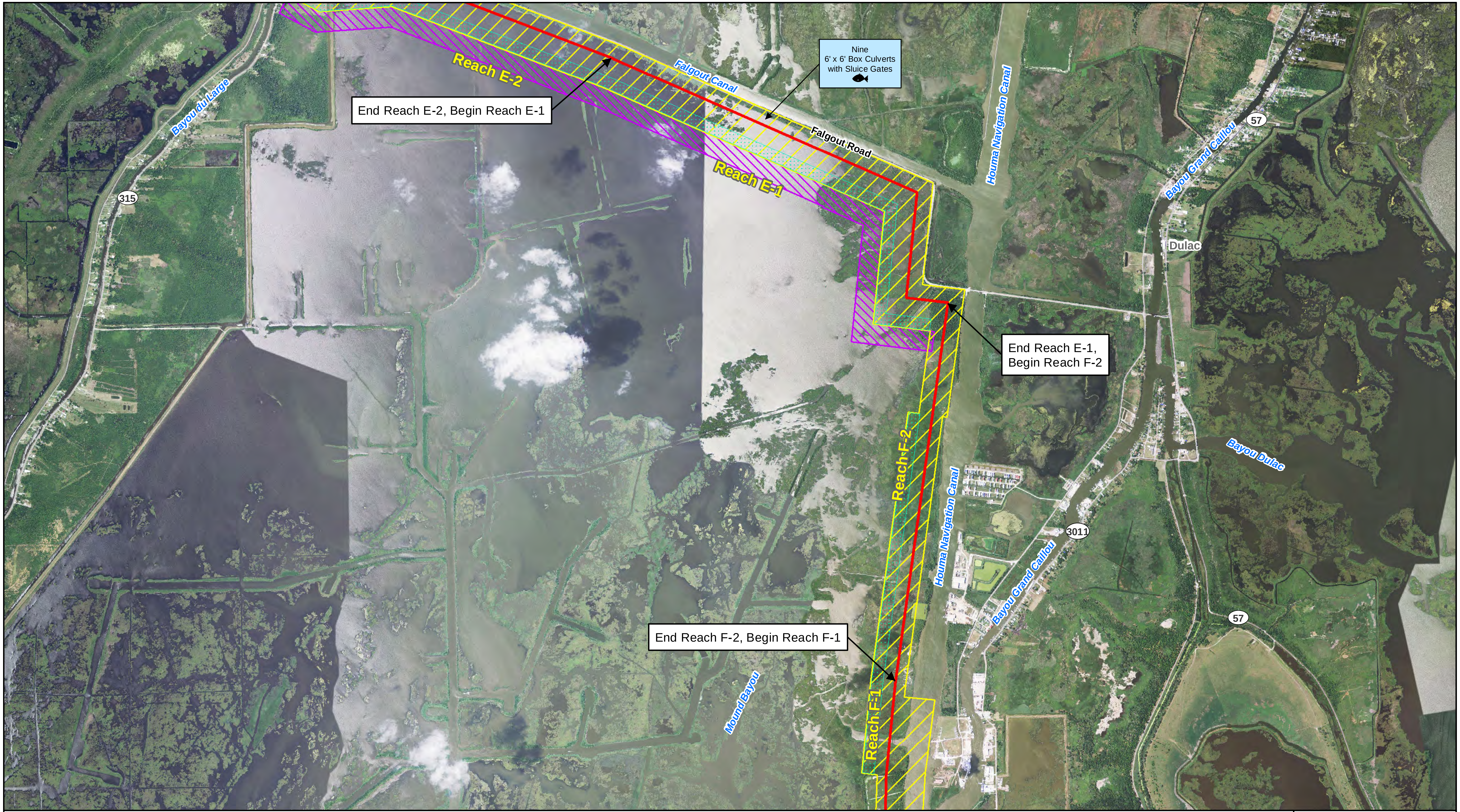

Legend

- PumpStations
- Centerline
- Right of Way
- NWR or WMA
- Mitigation Area
- Borrow Pits
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1% Annual Exceedance Probability Storm Surge Risk Reduction System Alternative

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Revised Programmatic Environmental Impact Statement

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N

0 1,200 2,400 Feet

GEC
Gulf Engineers & Consultants

Figure: 06 of 14
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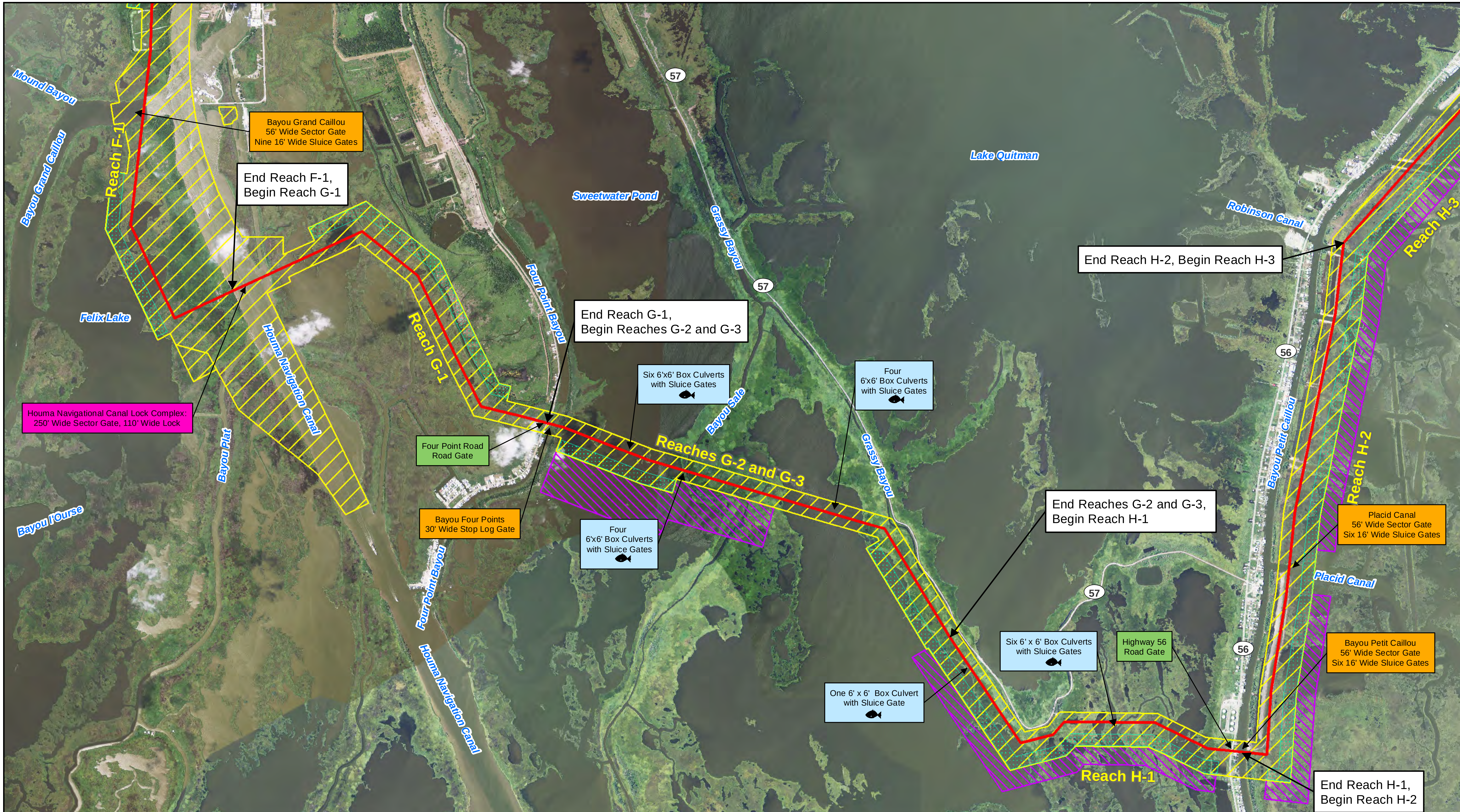

Legend

- PumpStations
- Centerline
- Right of Way
- NWR or WMA
- Mitigation Area
- Borrow Pits
- 1 Sluice Gate, 6 Box Culverts — Environmental Water Control Structure

1% Annual Exceedance Probability Storm Surge Risk Reduction System Alternative

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

2010 USDA-FSA-APFO NAIP MrSID Mosaics: Lafourche and Terrebonne Parishes

N

0 1,200 2,400 Feet

GEC
Gulf Engineers & Consultants

Figure: 07 of 14
Date: June 2012
Scale: 1:28,800
Source: USDA/GEC
Map ID: 273160010-3004

Legend

PumpStations
Centerline
Right of Way
NWR or WMA
Mitigation Area
Borrow Pits
1 Sluice Gate, 6 Box Culverts
Environmental Water Control Structure

1% Annual Exceedance Probability Storm Surge Risk Reduction System Alternative

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

2010 USDA-FSA-APFO NAIP MrSID Mosaics: Lafourche and Terrebonne Parishes

N

0 1,200 2,400 Feet

GEC
Gulf Engineers & Consultants

Figure: 08 of 14
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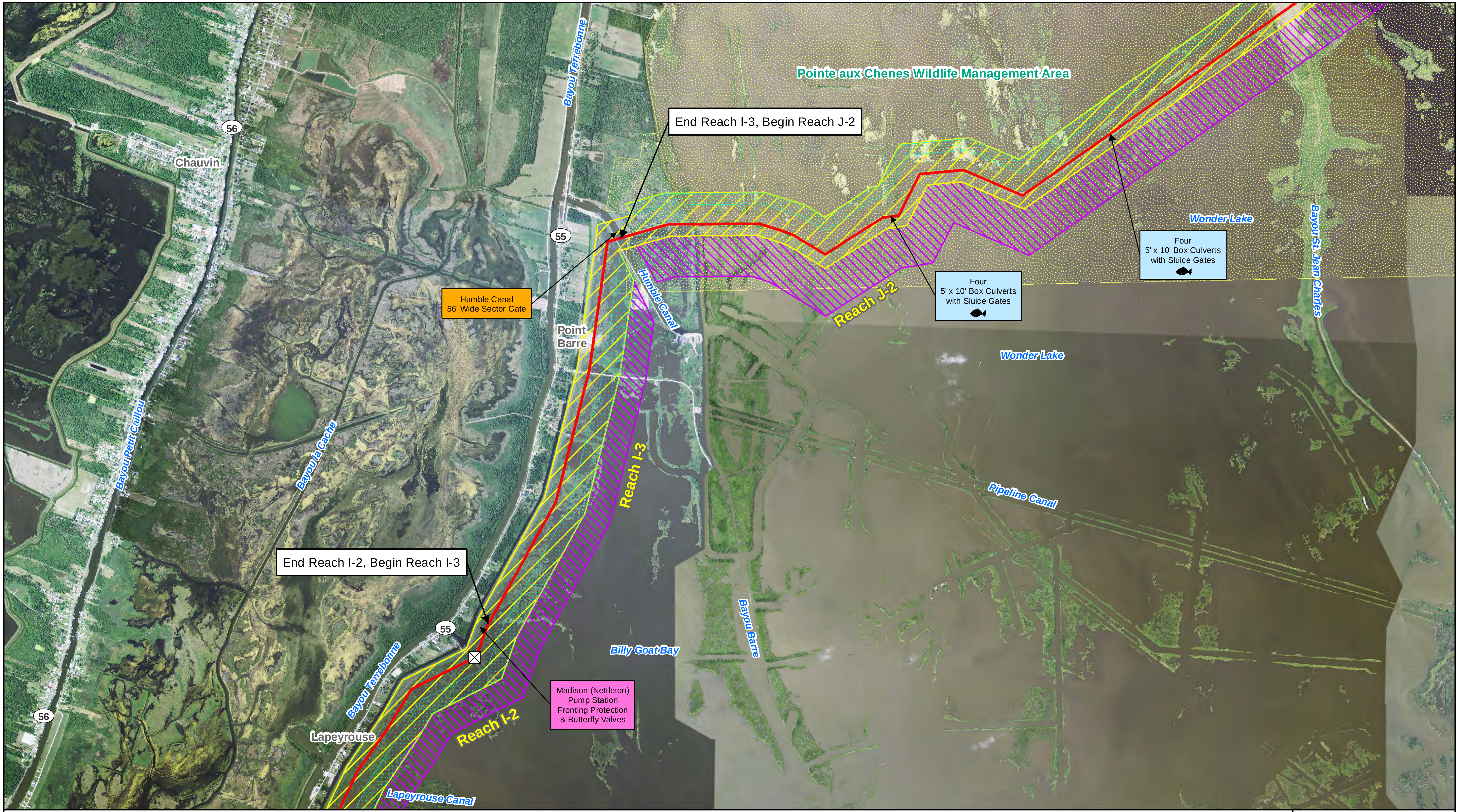

Legend

- PumpStations
- Centerline
- Right of Way
- NWR or WMA
- Mitigation Area
- Borrow Pits
- 1 Sluice Gate, 6 Box Culverts — Environmental Water Control Structure

1% Annual Exceedance Probability Storm Surge Risk Reduction System Alternative

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

2010 USDA-FSA-APFO NAIP MrSID Mosaics: Lafourche and Terrebonne Parishes

N

0 1,200 2,400 Feet

GEC
Gulf Engineers & Consultants

Figure: 09 of 14
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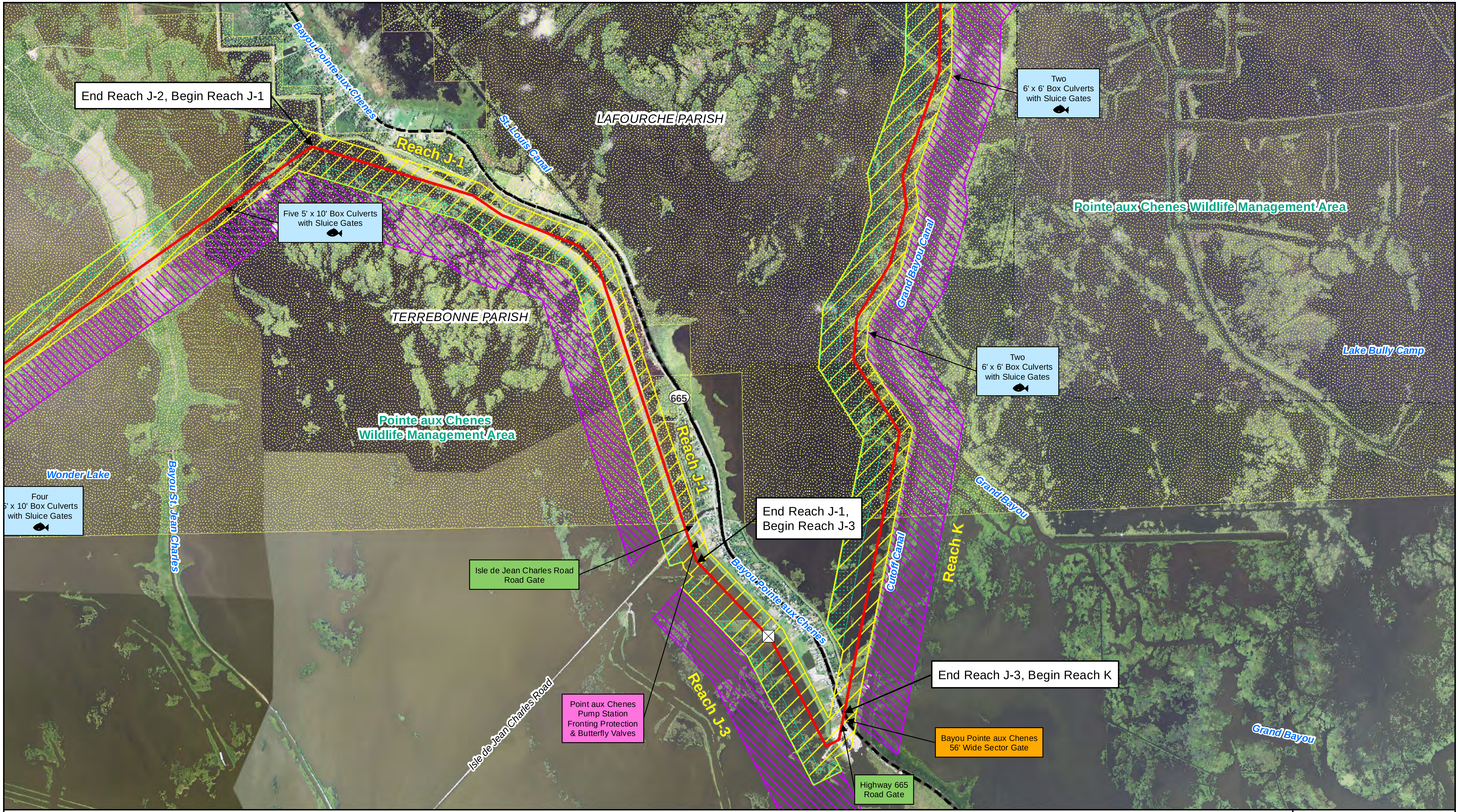

Legend

- PumpStations
- Centerline
- Right of Way
- NWR or WMA
- Mitigation Area
- Borrow Pits
- Environmental Water Control Structure (1 Sluice Gate, 6 Box Culverts)

1% Annual Exceedance Probability Storm Surge Risk Reduction System Alternative

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

2010 USDA-FSA-APFO NAIP MrSID Mosaics: Lafourche and Terrebonne Parishes

N

0 1,200 2,400 Feet

GEC
Gulf Engineers & Consultants

Figure: 10 of 14
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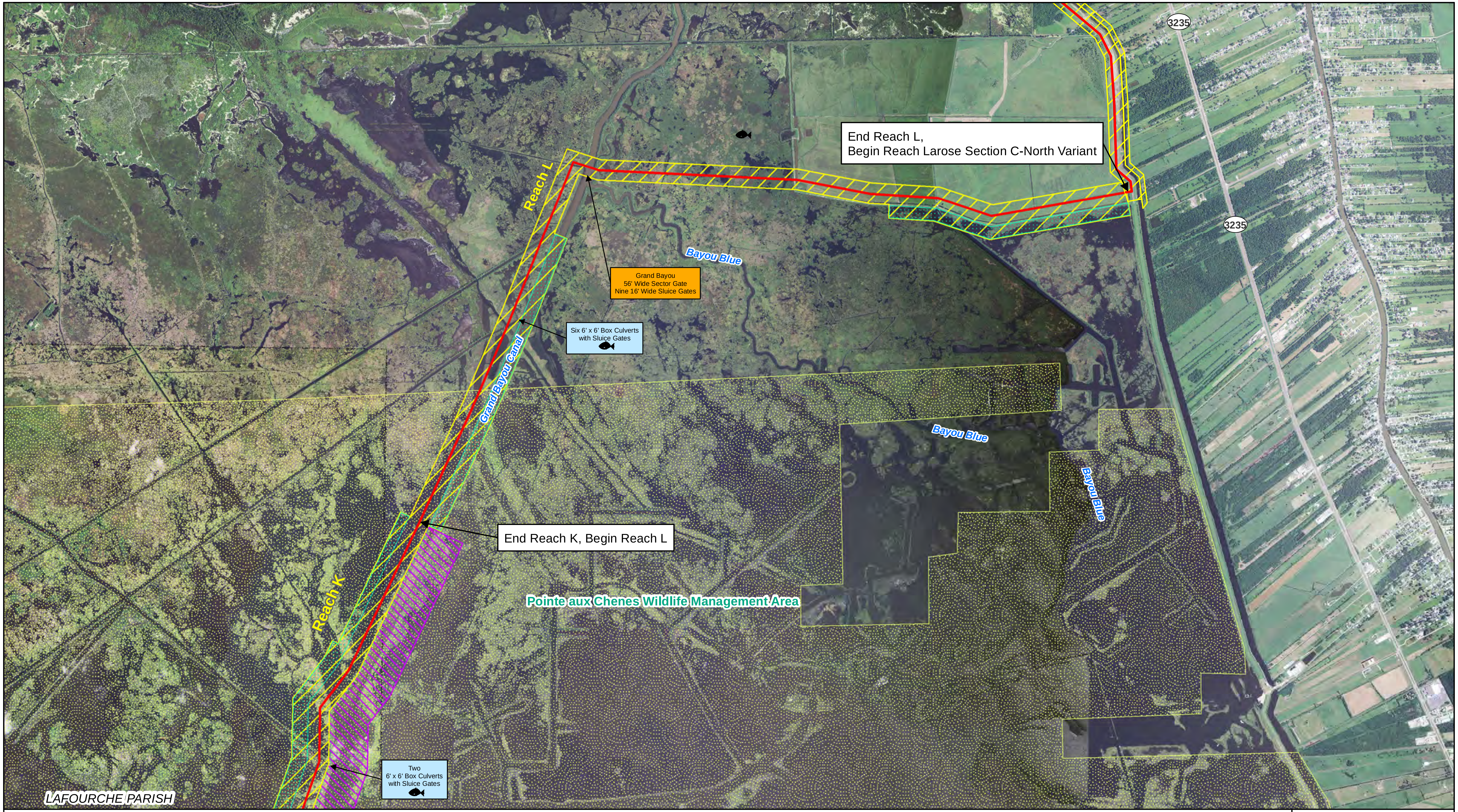

Legend

- PumpStations
- Centerline
- Right of Way
- NWR or WMA
- Mitigation Area
- Borrow Pits
- 1 Sluice Gate, 6 Box Culverts — Environmental Water Control Structure

1% Annual Exceedance Probability Storm Surge Risk Reduction System Alternative

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

2010 USDA-FSA-APFO NAIP MrSID Mosaics: Lafourche and Terrebonne Parishes

N

0 1,200 2,400 Feet

GEC Gulf Engineers & Consultants

Figure: 11 of 14	
Date: June 2012	
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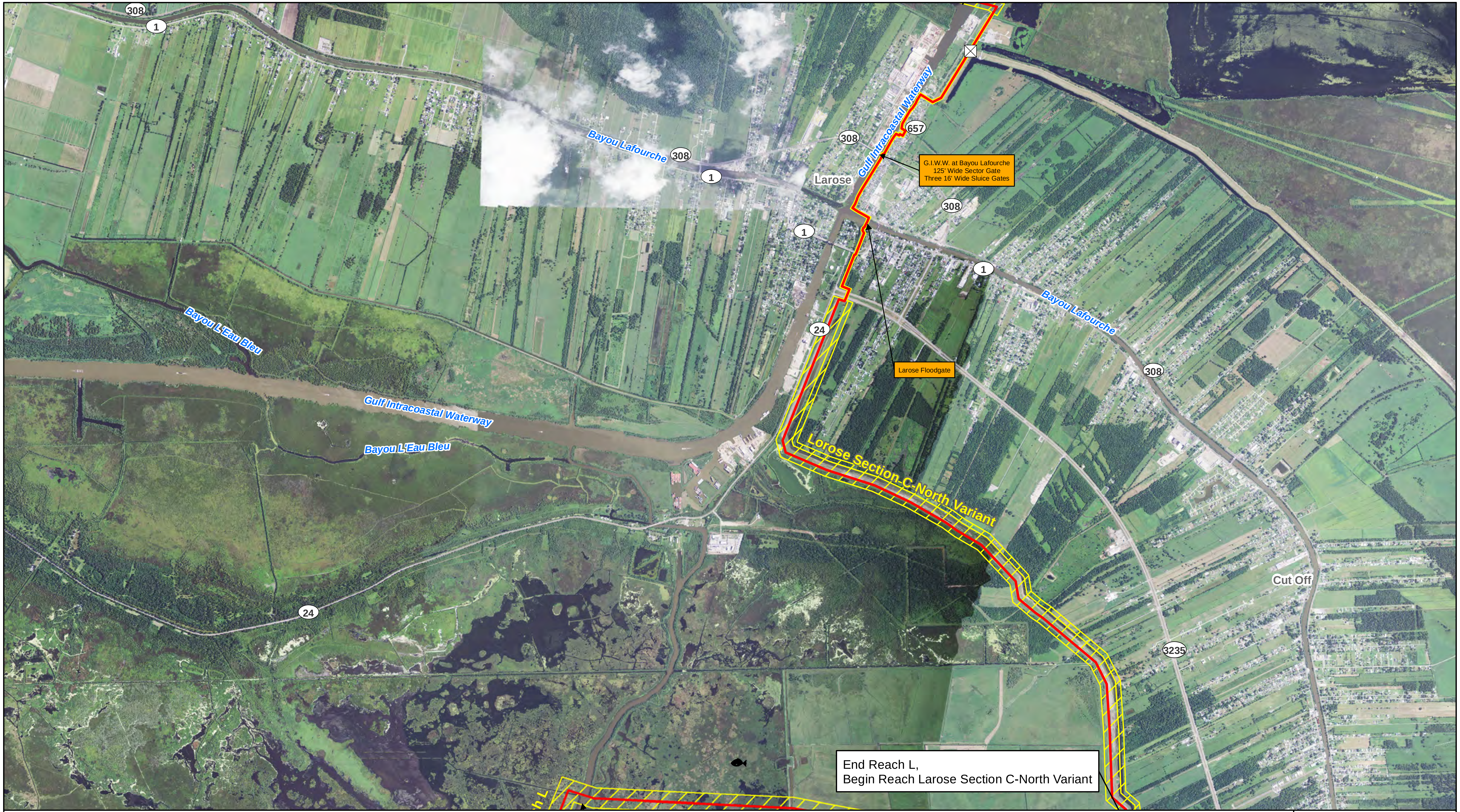

Legend
- PumpStations
- Centerline
- Right of Way
- NWR or WMA
- Mitigation Area
- Borrow Pits
- 1 Sluice Gate, 6 Box Culverts — Environmental Water Control Structure

1% Annual Exceedance Probability Storm Surge Risk Reduction System Alternative

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

2010 USDA-FSA-APFO NAIP MrSID Mosaics: Lafourche and Terrebonne Parishes

N

0 1,200 2,400 Feet

GEC Gulf Engineers & Consultants

Figure: 12 of 14
Date: June 2012
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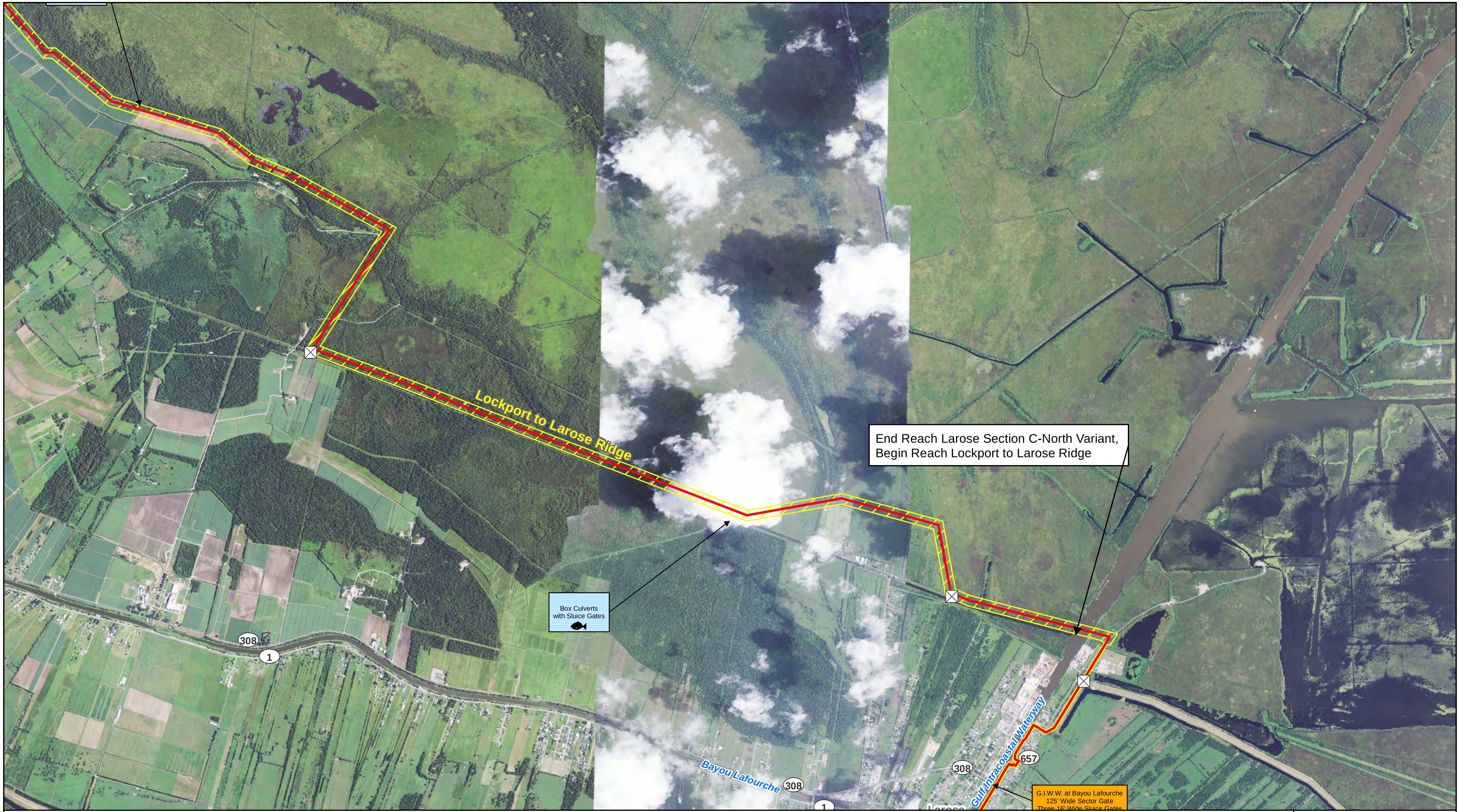
Map ID: 273160010-3004



Legend

- PumpStations
- Centerline
- Right of Way
- NWR or WMA
- Mitigation Area
- Borrow Pits
- Environmental Water Control Structure (1 Sluice Gate, 6 Box Culverts)

1% Annual Exceedance Probability Storm Surge Risk Reduction System Alternative

Morganza to the Gulf of Mexico, Louisiana
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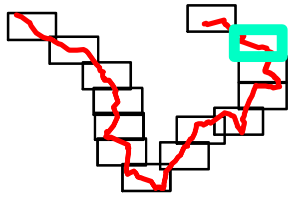
2010 USDA-FSA-APFO NAIP MrSID Mosaics: Lafourche and Terrebonne Parishes



N

0 1,200 2,400 Feet

Gulf Engineers & Consultants

Figure: 13 of 14
Date: June 2012
Scale: 1:36,000
Source: USDA/GEC
Map ID: 273160010-3004

Legend

- PumpStations
- Centerline
- Right of Way
- NWR or WMA
- Mitigation Area
- Borrow Pits
- 1 Sluice Gate, 6 Box Culverts — Environmental Water Control Structure

1% Annual Exceedance Probability Storm Surge Risk Reduction System Alternative

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

2010 USDA-FSA-APFO NAIP MrSID Mosaics: Lafourche and Terrebonne Parishes

N

0 1,200 2,400 Feet

GEC
Gulf Engineers & Consultants

Figure: 14 of 14
Date: June 2012
Scale: 1:36,000
Source: USDA/GEC
Map ID: 273160010-3004

Legend

- PumpStations
- Centerline
- Right of Way
- NWR or WMA
- Mitigation Area
- Borrow Pits
- 1 Sluice Gate, 6 Box Culverts — Environmental Water Control Structure

3% Annual Exceedance Probability Storm Surge Risk Reduction System Alternative

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

2010 USDA-FSA-APFO NAIP MrSID Mosaics: Lafourche and Terrebonne Parishes

N

0 1,200 2,400 Feet

GEC
Gulf Engineers & Consultants

Figure: 01 of 12
Date: June 2012
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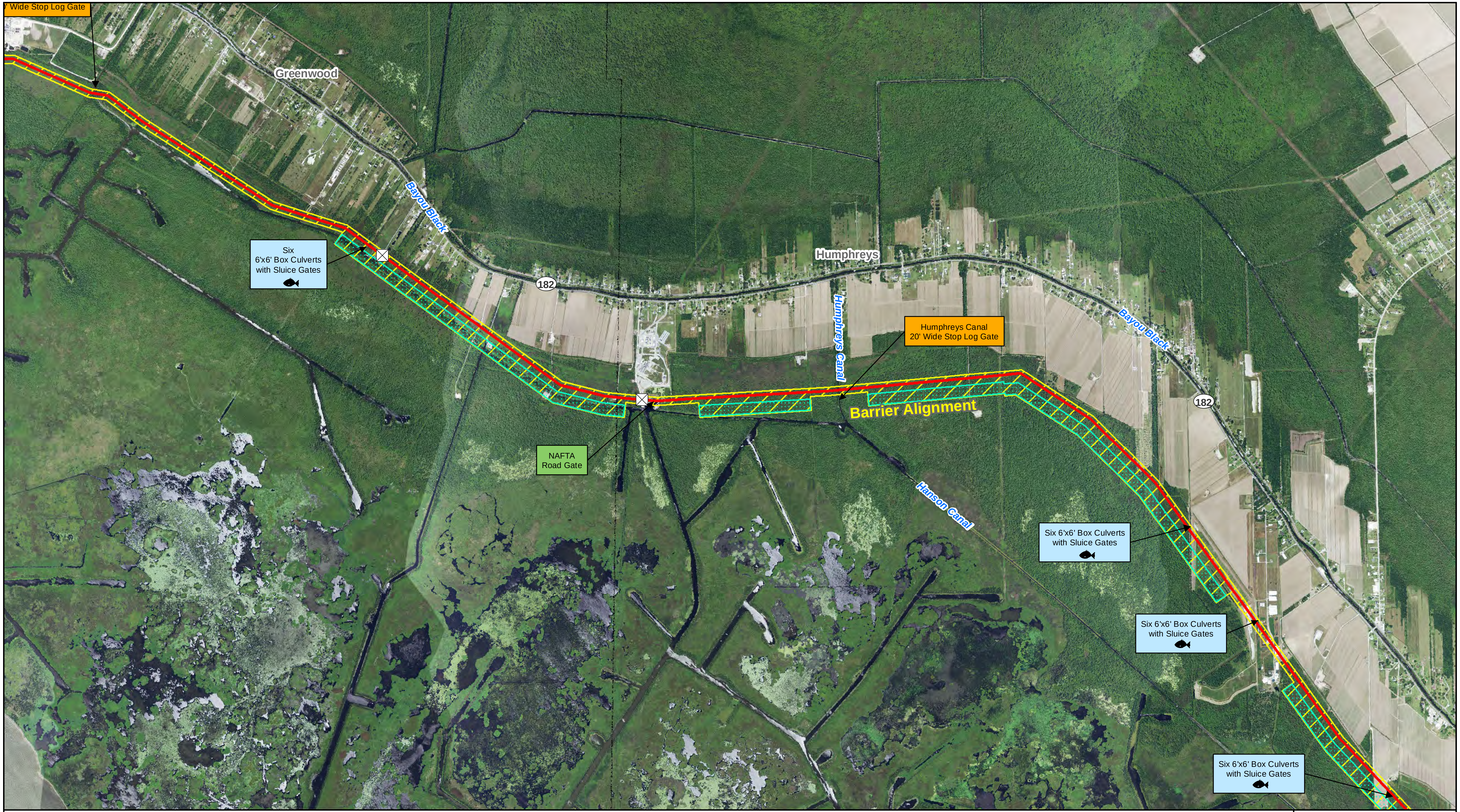


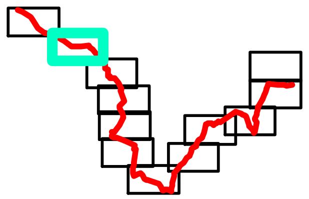
Legend

- PumpStations
- Centerline
- Right of Way
- NWR or WMA
- Mitigation Area
- Borrow Pits
- 1 Sluice Gate, 6 Box Culverts — Environmental Water Control Structure

3% Annual Exceedance Probability Storm Surge Risk Reduction System Alternative

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

2010 USDA-FSA-APFO NAIP MrSID Mosaics: Lafourche and Terrebonne Parishes



N

0 1,200 2,400 Feet

GEC
Gulf Engineers & Consultants

Figure: 02 of 12
Date: June 2012
Scale: 1:28,800
Source: USDA/GEC
Map ID: 273160010-3004

Legend

PumpStations

Centerline

Right of Way

NWR or WMA

Mitigation Area

Borrow Pits

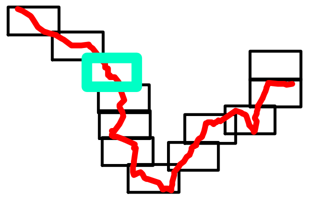
1 Sluice Gate, 6 Box Culverts — Environmental Water Control Structure

3% Annual Exceedance Probability Storm Surge Risk Reduction System Alternative

Morganza to the Gulf of Mexico, Louisiana

Revised Programmatic Environmental Impact Statement

2010 USDA-FSA-APFO NAIP MrSID Mosaics: Lafourche and Terrebonne Parishes



N

0 1,200 2,400 Feet

GEC

Gulf Engineers & Consultants

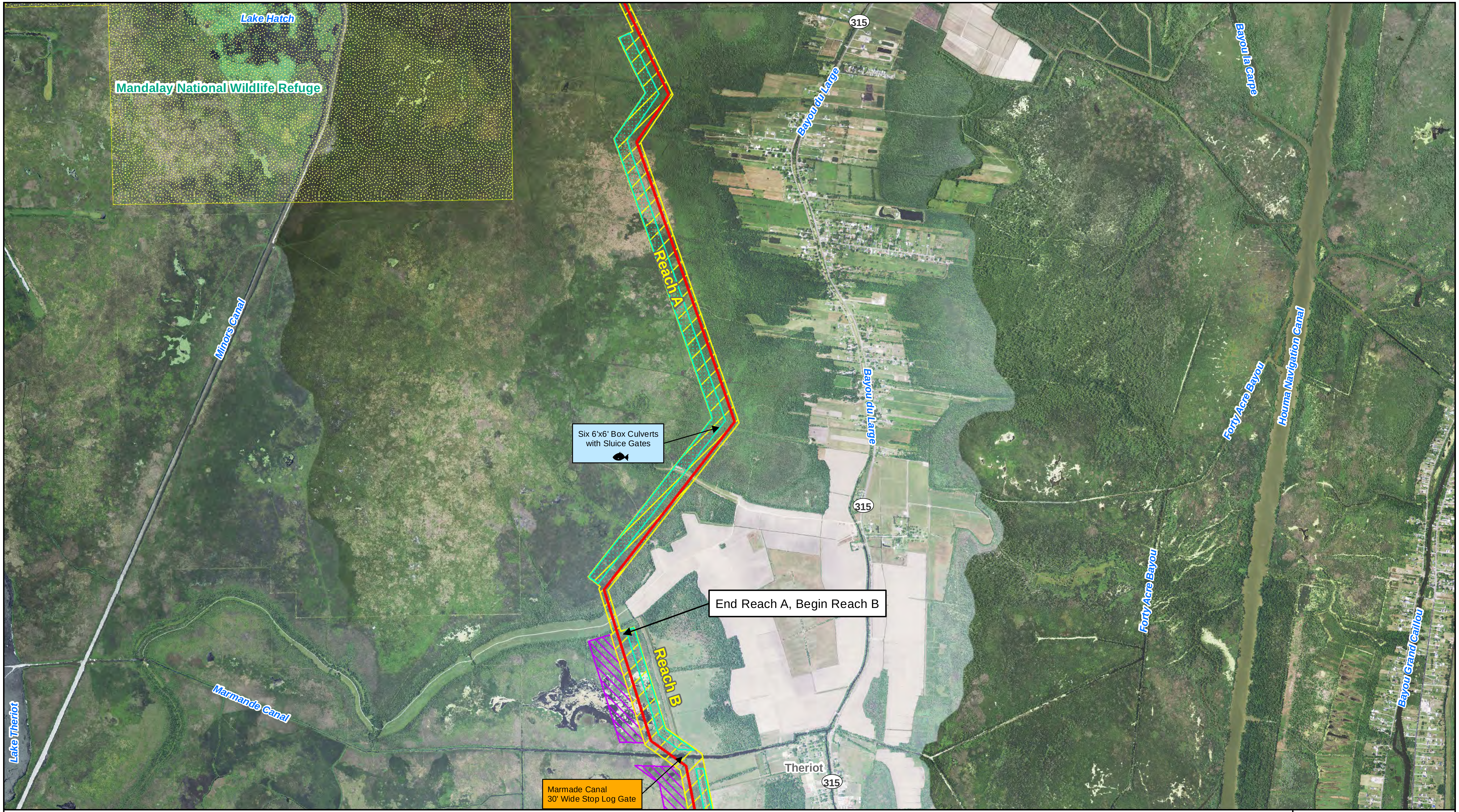
Figure: 03 of 12

Date: June 2012

Scale: 1:28,800

Source: USDA/GEC

Map ID: 273160010-3004



Legend

- PumpStations
- Centerline
- Right of Way
- NWR or WMA
- Mitigation Area
- Borrow Pits
- 1 Sluice Gate, 6 Box Culverts — Environmental Water Control Structure

3% Annual Exceedance Probability Storm Surge Risk Reduction System Alternative

Morganza to the Gulf of Mexico, Louisiana
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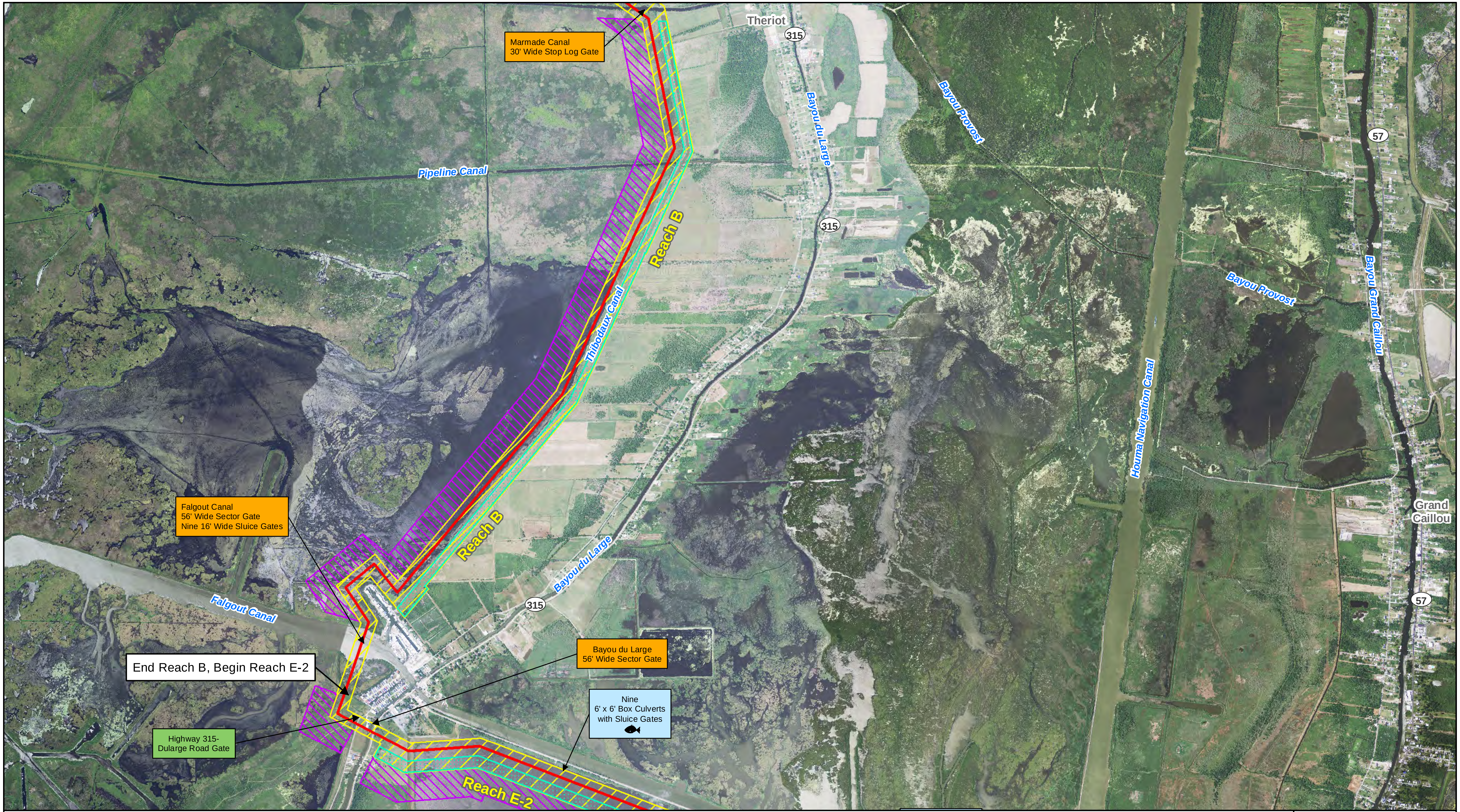
N

0 1,200 2,400 Feet

GEC Gulf Engineers & Consultants

Figure: 04 of 12
Date: June 2012
Scale: 1:28,800
Source: USDA/GEC
Map ID: 273160010-3004



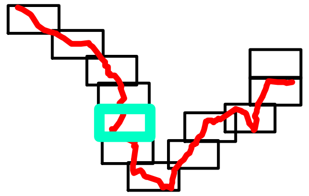
Legend

PumpStations	Mitigation Area
Centerline	Borrow Pits
Right of Way	Environmental Water Control Structure (1 Sluice Gate, 6 Box Culverts)
NWR or WMA	

3% Annual Exceedance Probability Storm Surge Risk Reduction System Alternative

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

2010 USDA-FSA-APFO NAIP MrSID Mosaics: Lafourche and Terrebonne Parishes



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GEC Gulf Engineers & Consultants

Figure: 05 of 12
Date: June 2012
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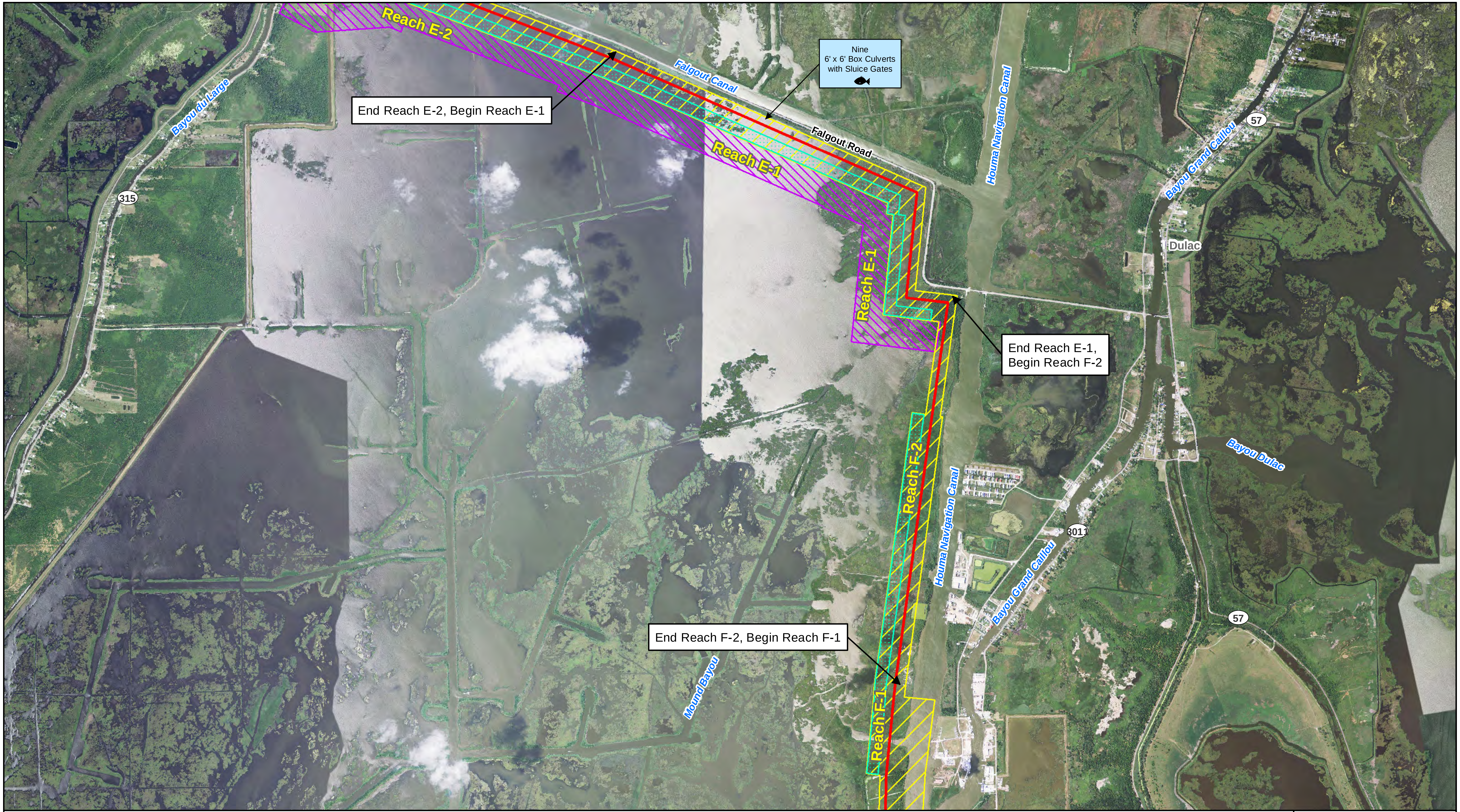
Source: USDA/GEC
Map ID: 273160010-3004



Legend

- PumpStations
- Centerline
- Right of Way
- NWR or WMA
- Mitigation Area
- Borrow Pits
- Environmental Water Control Structure (1 Sluice Gate, 6 Box Culverts)

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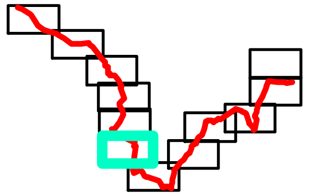

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GEC
Gulf Engineers & Consultants

Figure: 06 of 12
Date: June 2012
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Source: USDA/GEC
Map ID: 273160010-3004

Legend

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Gulf Engineers & Consultants

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Date: June 2012
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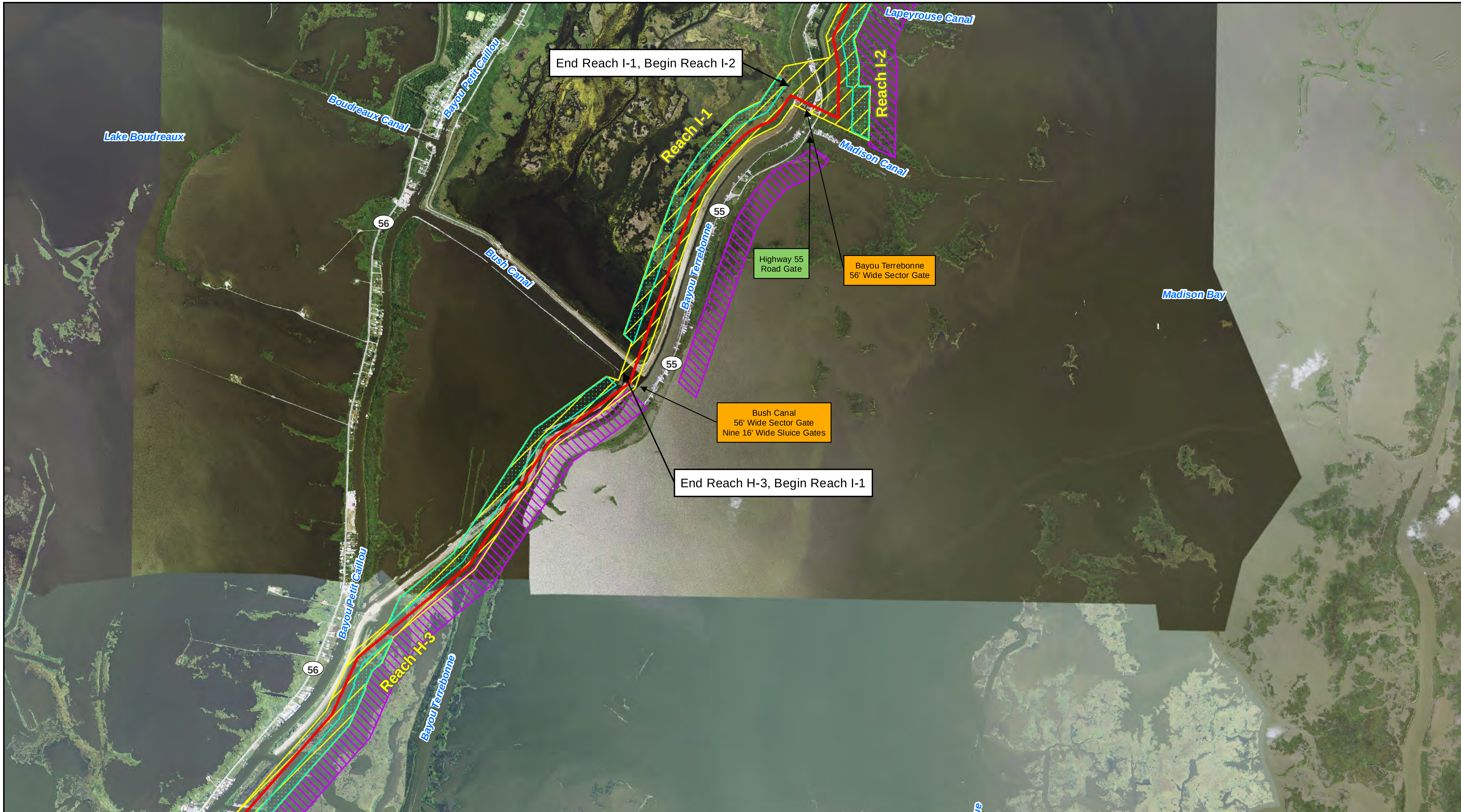

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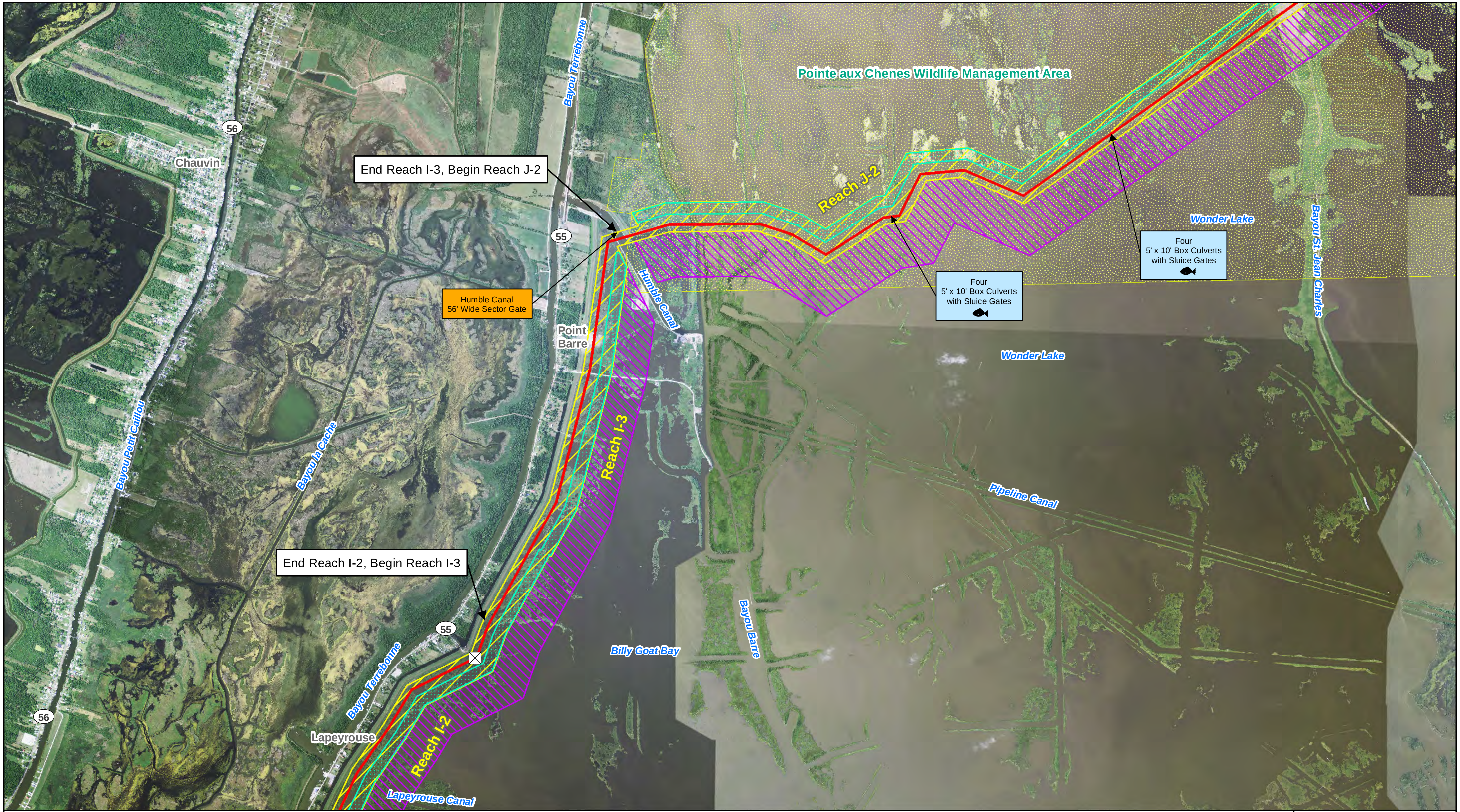

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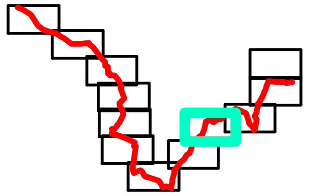

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Gulf Engineers & Consultants

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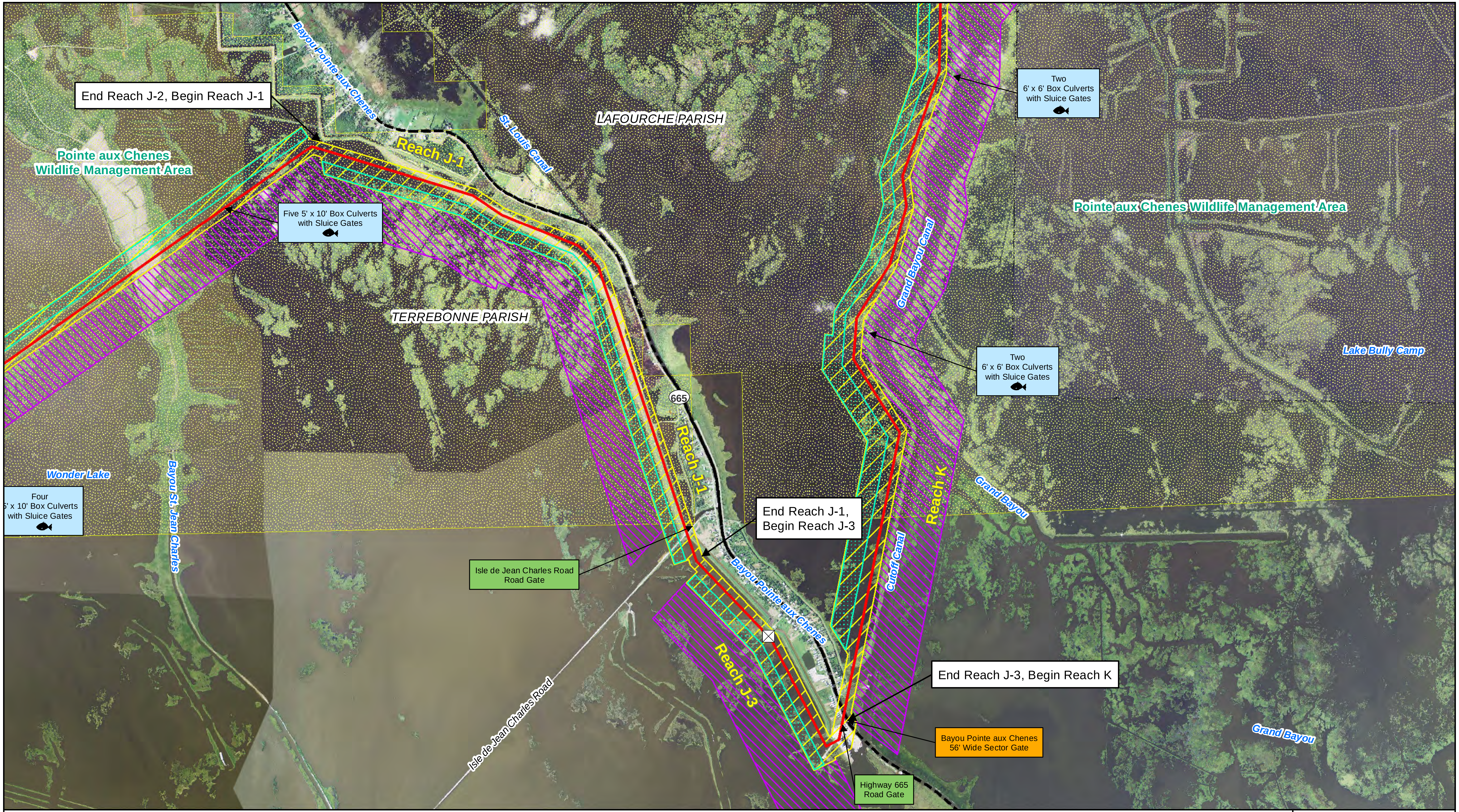

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Figure: 10 of 12
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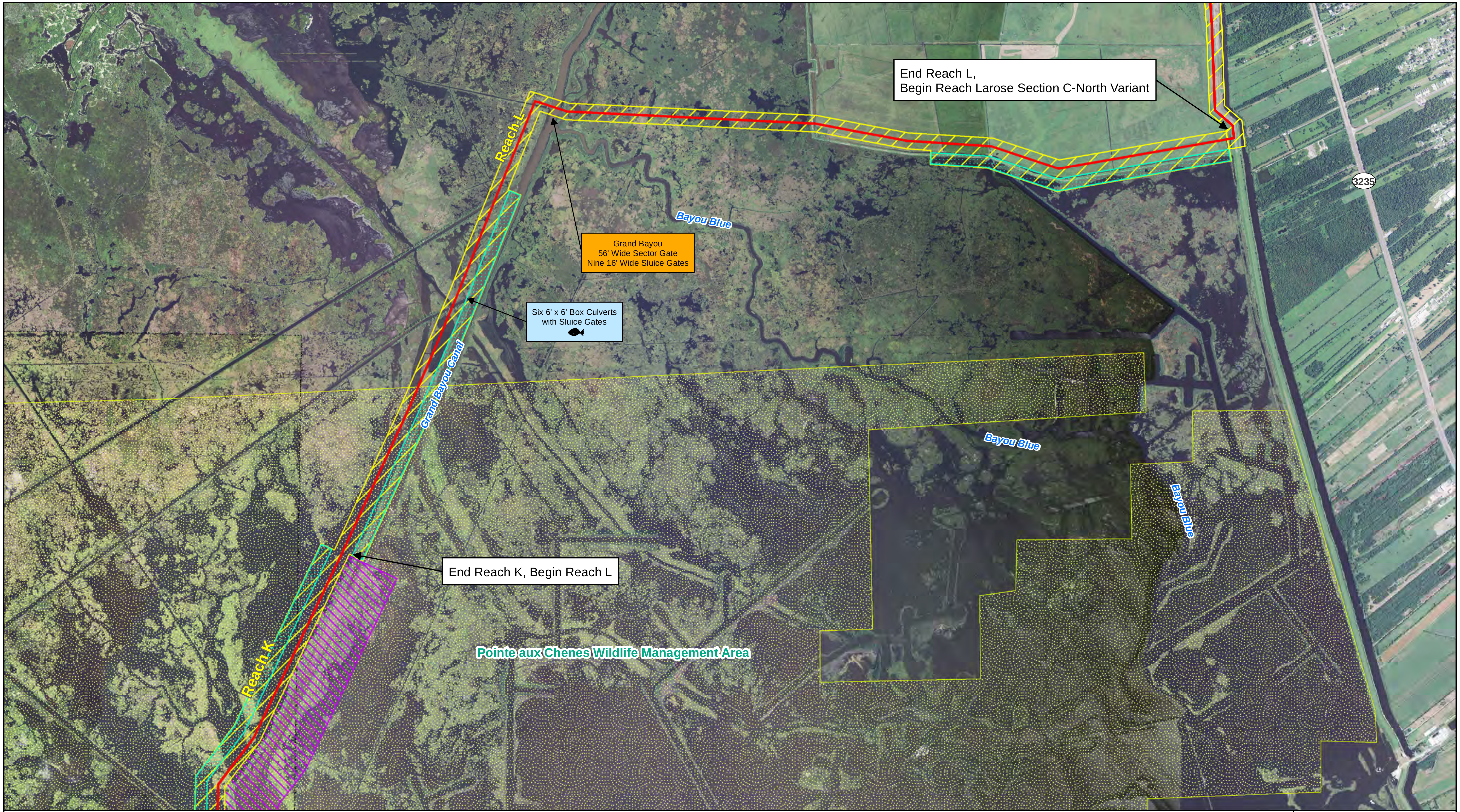

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Figure: 11 of 12
Date: June 2012
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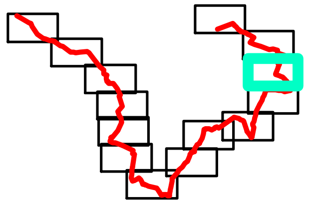

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Gulf Engineers & Consultants

Figure: 12 of 12
Date: June 2012
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GEC
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Figure: 14 of 12
Date: June 2012
Scale: 1:28,800
Source: USDA/GEC
Map ID: 273160010-3004

Appendix H

AGENCY COORDINATION

Letter 34

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702
(727) 570-5312; Fax 570-5517
http://caldera.sero.nmfs.gov

MAR 18 2002 F/SER3:DLK:mdh

Mr. Nathan Dayan
Planning, Programs, and Compliance Branch
CEMVN-PM-RS
U.S. Army Corps of Engineers
P.O. Box 60267
New Orleans, LA 70160-0267

Dear Mr. Dayan:

This correspondence is in reply to the letter and Draft Feasibility Report (Volume I), received November 29, 2001, and Volumes II and III (including the Biological Assessment), received January 8, 2002, from the U.S. Army Corps of Engineers (Corps), New Orleans District. The feasibility study is for a plan to provide additional protection from hurricane surge flooding for portions of the Terrebonne and Lafourche Parishes in southeast Louisiana. National Marine Fisheries Service (NMFS) comments are rendered pursuant to the Endangered Species Act of 1973 (ESA). The NMFS consultation number for this project is I/SER/2001/01141; please refer to this number in future correspondence on this project.

The proposed project consists of the construction of a system of levees and floodgates designed to provide protection from a 100-year hurricane event. Two versions of the plan have been proposed. The original included 87 miles of levees, 11 floodgates, a lock, 12 fish and wildlife structures, and several drainage structures, while the modified plan has 72 miles of levees and the same number of structures. The strategy is to provide flood control and wetland protection through this project, with its primary feature being a levee/flood wall that starts at the western side of the Terrebonne Parish, traverses the southern portion of the parish, and connects with the south Lafourche hurricane protection system at Larose.

ESA listed species under NMFS' purview which potentially occur in the Gulf of Mexico off Louisiana include: the Gulf sturgeon (*Acipenser oxyrinchus desotoi*); five species of sea turtles including the green (*Chelonia mydas*), loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and hawksbill (*Eretmochelys imbricata*); and five species of whales including the northern right (*Eubalaena glacialis*), finback (*Balaenoptera physalus*), humpback (*Megaptera novaeangliae*), sei (*Balaenoptera borealis*), and sperm (*Physeter catodon*).

None of the whale species are expected to be found near the project area. Leatherback and hawksbill turtles are highly unlikely to occur near the project area. The work is going to occur in coastal waters and coastal marsh areas, with construction occurring "several miles from Gulf edge marshes" where it is unlikely that loggerhead, Kemp's ridley or green turtles will occur. There are no nesting beaches in the area that would be impacted directly or indirectly. The construction activity, levees, and floodgates are not planned in Gulf sturgeon spawning sites and should not significantly impact other sturgeon habitat. Based upon this review, NMFS believes that the proposed action is not likely to adversely affect any listed species under NMFS' purview for any of the plan alternatives.

This concludes the Corps' consultation responsibilities under section 7 of the ESA for the proposed actions for federally listed species, and their critical habitat, under NMFS' purview. Consultation should be reinitiated if there is a take, new information reveals impacts of the proposed actions that may affect listed species or their critical habitat, a new species is listed, the identified action is subsequently modified, or critical habitat designated that may be affected by the proposed activity.

Pursuant to the essential fish habitat consultation requirements of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1855(b)(2) and 50 CFR 600.905-.930, Subpart K), the NMFS Habitat Conservation Division (HCD) is being copied with this letter. The HCD biologist for this region is Richard Hartman. If you have any questions about consultation regarding essential fish habitat for this project, please contact Mr. Hartman at (225) 389-0508.

If you have any questions, please contact Dennis Klemm, fishery biologist, at the number above or by e-mail at Dennis.Klemm@noaa.gov.

Sincerely,

for, Joseph E. Powers, Ph.D.
Acting Regional Administrator

cc: F/PR3
F/SER44- R. Hartman

File: 1514-22 f.1 LA
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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

Southeast Regional Office
9721 Executive Center Drive N.
St. Petersburg, FL 33702
(727) 570-5312, Fax 570
http://caldera.sero.nmfs.gov

MAR 18 2002   F/SER

nce Branch

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II and III (including the Biological Assessment) received
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34-1 Corps response: Comment noted.

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a.gov

Sincerely

for, Joseph E. Powers, Ph.D.
Acting Regional Administrator

d

34-2 Corps response: Comment noted.

Appendix I

WATER QUALITY CERTIFICATE APPLICATION

APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT
(33 CFR 325)

OMB APPROVAL NO. 0710-003
Expires October 1996

Public reporting burden for this collection of information is estimated to average 5 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Service Directorate of Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003), Washington, DC 20503. Please DO NOT RETURN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location of the proposed activity.

PRIVACY ACT STATEMENT

Authority: 33 USC 401, Section 10; 1413, Section 404. Principal Purpose: These laws require permits authorizing activities in, or affecting, navigable waters of the United States, the discharge of dredged of fill material into waters of the United States, and the transportation of dredged material for the purpose of dumping it into ocean waters. Routine Uses: Information provided on this form will be used in evaluating the application or a permit. Disclosure: Disclosure of requested information is voluntary. If information is not provided, however, the permit application cannot be processed nor can a permit be issued.

One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	***2. FIELD OFFICE CODE***	***3. DATE RECEIVED***	***4. DATE APPLICATION COMPLETED***

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME US Army Corps of Engineers, New Orleans District	*8. AUTHORIZED AGENT'S NAME AND TITLE (an agent is not required)* Same as Applicant
6. APPLICANT'S ADDRESS Regional Planning Division South CEMVN-PDN-CEP P.O. Box 60267 New Orleans, LA 70160-0267 ATTN: *Nathan Dayan*	***9. AGENT'S ADDRESS***
7. APPLICANT'S PHONE NOS. W/AREA CODE	*10. AGENT'S PHONE NOS. W/AREA CODE*
a. Residence ***b. Business*** (504) 862-2530	*a. Residence* *b. Business*

11. STATEMENT OF AUTHORIZATION

The study is authorized by: House Resolution, Docket 2376, April 30, 1992; and WRDA 96 (PL 104-303, Sec 425) the Energy and Water Development Appropriation Act of 1995 (PL 103-316), Section 425 of WRDA 96 (PL 104-303), Section 158 of the Energy and Water Development Appropriations Act, 2004 (PL 108-137), and Section 1001 of WRDA 2007 (Public Law 110-114) authorized construction for the project for:

> *hurricane and storm damage reduction, Morganza to the Gulf of Mexico, Louisiana: Reports of the Chief of Engineers dated August 23, 2002, and July 22, 2003, at a total cost of $886,700,000, with an estimated Federal cost of $576,355,000and an estimated non-Federal cost of $310,345,000. The operation, maintenance, repair, rehabilitation, and replacement of the Houma Navigation Canal lock complex and the Gulf Intracoastal Waterway floodgate features of the project described in subparagraph (A) that provide for inland waterway transportation shall be a Federal responsibility in accordance with section 102 of the Water Resources Development Act of 1986 (33 U.S.C. 2212).*

The Post Authorization Change (PAC) report and Revised Programmatic Environmental Impact Statement have been prepared.

____

APPLICANT'S SIGNATURE *DATE*

NAME, LOCATION AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE (see instructions)
Mississippi River and Tributaries Morganza to the Gulf of Mexico, Louisiana Project

13. NAME OF WATERBODY, IF KNOWN (if applicable)

Multiple – Houma Navigation Canal, Bayou Black, GIWW, Bayou du Large, Bayou Grand Caillou, Bayou Terrebonne, Bayou Petit Caillou, Bayou Blue, Bayou Petit Caillou, Lake Boudreaux, Grand Bayou, Sweet Water Pond, etc

14. PROJECT STREET ADDRESS (if applicable)

See attached figure

15. LOCATION OF PROJECT

Terrebonne (COUNTY) — Louisiana (STATE)

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN, (see instructions)

See attached figure

17. DIRECTIONS TO THE SITE

See attached figure

18. Nature of Activity (Description of project, include all features.)

1% Annual Exceedance Probability Storm Surge Risk Reduction System (1% AEP Alternative) provides risk reduction for water levels that have a 1% chance of occurring each year (see figure). This alternative includes programmatic elements that would be further investigated in the future and constructible elements for which this water quality application is requested. The features that have been to be identified as constructible include, Levee Reach F1 and F2, Levee Reach G1, HNC Lock Complex (HNC Lock), and Bayou Grand Caillou Floodgate (BGC floodgate).

The 98-mile levee system would extend from high ground along US 90 near the town of Gibson and tie into Highway 1 near Lockport, LA in Lafourche Parish. Planned levee elevations range from 15.0 to 26.5 feet NAVD88. Toe-to-toe levee widths range from 282 feet to 725 feet. Twenty-two navigable floodgate structures, ranging in elevation from 17.0 to 33 feet (NAVD88), would be located on waterways throughout the levee system, including a lock complex on the HNC. Additionally, environmental water control structures would allow tidal exchange at 23 locations through the levee through sluice gates and box culverts.

Nine road gates would be located at the following levee/road crossings: NAFTA, Four Pointe Road, Highway 315 (DuLarge), Highway 55, Highway 56, Hwy 24, Hwy 3235, Union Pacific RR and Highway 665. Fronting protection would be provided for four pumping stations, including the Madison, Pointe aux Chenes, Elliot Jones (Bayou Black), and Hanson Canal pump stations.

Levees would be constructed using a combination of sidecast and hauled-in borrow materials. Adjacent side cast was planned for the pre-load section only. Borrow pits are oversized to offset the potential for encountering organics, expected losses, etc. The project would involve constructing 22 navigable floodgates, 23 environmental water control structures, six road gates, and fronting protection for four existing pumping stations. Structures on Federally maintained navigation channels include the Houma Navigation Canal Lock Complex (and 250-ft sector gate) and two 125-ft sector gates on the GIWW east and west of Houma. In addition, thirteen 56-ft sector gates and five 20- to 30-ft stop log gates are located on various waterways that cross the levee system.

19. Project Purpose (Describe the reason or purpose of the project, (see instruction.)

The purpose of this project is to provide hurricane and storm damage risk reduction for the communities located within the levee system. The goal is to maximize the number of residential and commercial structures protected from damage caused by hurricane storm surges.

USE BLOCKS 20-22 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

To build a levee system and required compensatory mitigation.

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Years.

Approximate 126 million cubic yards of earthen material (quality based on post-Katrina standards) would be used to build the complete levee alignment to its full height.

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

The constructible components of the 1% AEP Alternative would result in the filling of brackish and intermediate marshes and their conversion to uplands and open water. Table 6-1 summarizes the acres affected by the project's constructible and programmatic features.

Acres of Wetlands Directly Effected			
Features	**Tidal Wetlands**	**Force Drained Wetlands**	**Total wetlands**
Constructible Features	644.35	25.98	670.33
Programmatic Features*	3,017	31	3,048
Total Impact	3,661	57	3,718

23. Is Any Portion of the Work Already Complete? Yes _X____ No _____ IF YES, DESCRIBE THE COMPLETED WORK

Reach J1 was built covered in EA-406 and Water Quality Certificate #TR 031021-01 / AI 90947 / CER 2003000

24. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (If more than can be entered here, please attach a supplemental list.

Multiple

25. List of Other Certifications or Approvals/Denials Received from other Federal, State or Local Agencies for Work Described in This Application.

AGENCY	***TYPE APPROVAL***	***IDENTIFICATION NO.***	***DATE APPLIED***	***DATE APPROVED***	***DATE DENIED***

To the best of my knowledge the proposed activity described in my permit application complies with and will be conducted in a manner that is consistent with the LA Coastal management Program.
**Would include but is not restricted to zoning, building and flood plain permits.*

26. Application is hereby made for a permit or permits to authorize the work described in this application. I certify that the information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

___________________________________ ___________________ ______________________________________ ___________________

SIGNATURE OF APPLICANT *DATE* *SIGNATURE OF AGENT* *DATE*

The application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency The United States knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both.

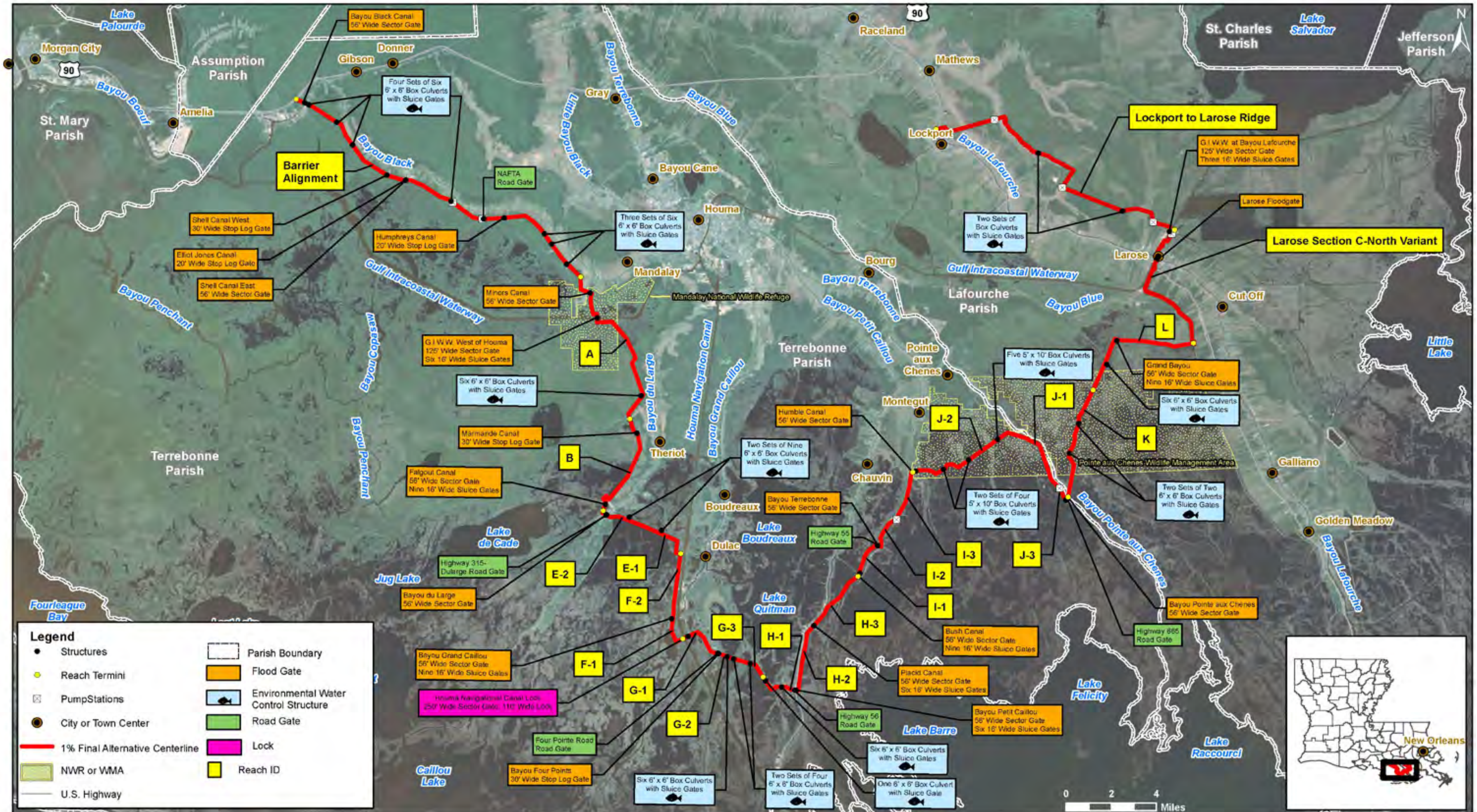

Figure 1. ALIGNMENT AND STRUCTURES OF THE 1% ANNUAL EXCEEDANCE PROBABILITY STORM SURGE RISK REDUCTION SYSTEM ALTERNATIVE

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

Image: I3 USA Prime Imagery

GEC
Gulf Engineers & Consultants

Figure: 1	
Date: June 2012	
Scale: 1:256,000	
Source: USACE/GEC	
Map ID: 273160010-2811	